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The Outlook for the Year

In this issue the *Electrical World* presents a number of signed statements on vital matters affecting the electrical industry. In so doing it calls attention not only to the matured views of those who express their opinions, but also to the fact that the subjects treated are of such serious importance that they demand earnest consideration. It can be taken for granted that, given any fair chance of development and times that are not unduly hard, central stations will make a good showing in increase of gross earnings. No other public utility industry is so bright with promise in this respect. This fortunate condition, however, should not blind the sight of central-station managers to the other problems on the horizon. Foremost among these problems at present are those that deal with public policy affairs. They touch the industry, not to retard its growth, but to question the lines on which that growth shall take place in the future. It rests largely with the industry to see that the lines of development are wholesome and will pass public scrutiny. With development in promise along these satisfactory lines, it rests with the public to withhold restrictive hands and to uphold gladly all policies that are constructively for the advancement of the company and the community it serves. Public inquiry into electrical matters has been insistent, and it will be more insistent in the future. The work that this imposes upon the industry is not to be regarded lightly. It means that the companies shall subject their own transactions to the same sort of critical analysis that they are likely to receive from commissions representing the public.

Work of the Standards Bureau

In his Atlanta paper, extracts from which are published in this issue, Dr. Rosa says that the engineers and experts of the Bureau of Standards are unbiased and absolutely independent. The *Electrical World* takes pleasure in testifying to the high character and earnest effort of those who have guided the bureau to its present position of standing and usefulness. No one should withhold from them the credit that is their due. If work of the kind they have done is well done, there is a natural tendency for it to increase, and this has been the experience of the Bureau of Standards. Certainly the scope of activities of the bureau is much greater now than it was a few years ago. There is an inevitable drift toward a still further enlargement of activities, and Dr. Rosa outlines some of the ways in which services are to be rendered. In the technical investigations which have been conducted so acceptably by the bureau in the past, the personnel of its heads and associates has been a large influence making for success. It is greatly to be desired that the same high character that has influenced them shall always be manifest in the work. If it is, the assistance of the government will be a factor of much helpfulness in the solution of the technical problems of the industry and may be so anticipated.

The Big Creek Electric System

All things considered, the Big Creek system, described in this issue, is the most remarkable one yet put into operation in this country or anywhere else. In the first place, the transmission line is the longest straight-away system ever installed. We believe that its 240 miles reach has never been anywhere nearly equaled in regular work, although a similar distance has been spanned incidentally on the huge network of the Pacific Gas & Electric Company. Beyond this, its working voltage, starting off at 135,000, is the highest yet utilized commercially. It is not likely long to remain unsurpassed, however, even if for the moment it holds the record. Quite aside from these superlative features, the Big Creek plant has other extraordinary details which forcibly strike the attention. It is very notable, for instance, from the hydraulic standpoint. The drainage area is singularly small, only about 88 sq. miles, but the annual rainfall averages 80 in. or more, the basin being one of those unusual areas where the precipitation is abnormally high. Such conditions are now and then found in mountainous districts near the sea, as, for instance, in the east of Scotland. The run-off, too, a factor extraordinarily dependent on local conditions, rises to the remarkable figure of about 50 in. Moreover, the topographical conditions are such that the great volume of water can for the most part be successfully impounded without forbidding expense. In keeping with the scheme for water storage, a somewhat unusual wheel arrangement is used. The nozzles are stationary and controlled by needle valves. There are two independent oil-pressure governors, each controlling a single wheel and so arranged that either wheel of the unit can be worked quite independently so that partial loads may be handled with the greatest possible hydraulic efficiency. In addition, each governor operates a relief valve to take care of excessive rise of pressure in the pipe line. The bearings which carry the wheels and rotor are of unusual construction, with hollow forged steel shafts 20 in. in diameter resting in water-cooled babbitted bearings 5 ft. long,

being lubricated with auxiliary pressure-oil supply. The exciters are planned for either motor or impulse-wheel drive. These features are sufficient to mark the plant as of exceptional engineering interest quite aside from the voltage used or the length of the transmission. The plant was placed in service on Nov. 8, 1913, at 135,000 volts, and the pressure will be raised when needed to 150,000 volts, for which the line has been planned. It is really gratifying to record the starting of this very notable development, for it is not only altogether remarkable in voltage and range, but its design displays a degree of resourcefulness very pleasing in these days of banal standardization when prescriptions per catalog are too often the order of the day. Now and then a chance like this is given to the engineer to make real progress, and fortunate is he to whom it falls. By such plants does the art advance and the community benefit. Uncle Sam did well when he granted the permit for its construction.

Alternating-Current Rectifier

The experience gained during the past twenty years in the delivery of electric energy at large rates over long range has confirmed the conclusions which were reached at the outset as to the best conditions obtainable. For long-distance transmission between a single main generating station and a single main receiving station it is always a matter for special consideration whether the energy should be transmitted by direct or by alternating current. When, however, a network of high-tension lines may have to connect a plurality of stations, some generating and others consuming, then the alternating-current system is much more flexible. On the other hand, for general moderate-tension energy distribution, and especially for street-railway work, the direct-current system has distinct advantages. In America, at the present time, a very large aggregate amount of power is thus generated and used in transmitting energy to a distance, through the medium of alternating currents, and converted through synchronous apparatus for direct-current delivery and distribution.

The converter substation is a well-known element in energy distribution systems, and the efficiency of these substations is relatively high. Nevertheless, there is always inconvenience and expense in maintaining rotating machinery in substations. A stationary rectifying apparatus would have great advantages over synchronous converters in large systems. Every increase, therefore, in the available size, permissible output and effectiveness of mercury-vapor rectifiers is a distinct gain to the energy transmission engineer. If it were possible to carry on a railroad locomotive a transformer and rectifier of sufficient power to supply its motors with direct current effectively, the electrical system would indeed become very simple.

The *Electrotechnische Zeitschrift* has recently published an article, by Mr. J. Epstein, recording measurements made in a foundry and factory plant receiving rectified single-phase alternating current for motor operation, without the intervention of a storage battery. The energy was taken from single-phase alternating-current mains at 3 kilovolts pressure through a transformer, and delivered to a direct-current motor load of from 40 kw to 50 kw, through a bank of four metallic mercury-arc rectifiers. The efficiency of the rectification was about 90 per cent. Oscillograms accompanying the article indicate that when the load was non-inductive the delivered voltage and current were both pulsatory, and to a similar degree. When the load was highly inductive the current became less pulsatory, or had its pulsations smoothed out, but the pulsations in the delivered emf were increased. It is evident that hot-wire instruments will not give the same readings as Weston instruments in such a pulsatory current circuit. It would be interesting to see what effect the character of the load might have upon the wave-form on the alternating-current side of the rectifier.

Central Stations in Large Cities

An address recently delivered by Prof. G. Klingenberg before the British Institution of Electrical Engineers brings out some startling contrasts between the electricity supply systems in London, Berlin and Chicago. As our readers well know, the last-named city under a singularly progressive arrangement has a wonderfully well-organized system of unified supply. London, on the other hand, is an example of complete disorganization in spite of some remarkably well-managed local undertakings. Berlin has an orderly supply, although its territory is less completely controlled than in the case of Chicago. The enormous railway load in Chicago makes comparisons difficult, but some of the data gathered are decidedly instructive. The first striking fact is the very inefficient way in which the business has been exploited in London, doubtless attributable in part to the fact that most of the undertakings are municipal and as a rule in rather serious competition with cheap gas. With three times the population of Chicago, London uses for lighting and motor service less than 25 per cent more energy and has an insignificant railway load. Its sixty-four stations show 50 per cent greater first cost per kilowatt than the six plants that supply service to the Western metropolis, more than double the operating cost and 10 per cent less efficiency in the distributing system. Moreover, the London wage cost is 60 per cent higher than that in Chicago, and its fuel cost more than double.

Here certainly is evidence enough of the shocking inefficiency of small stations as against large ones, and there is too plain evidence of the difference between large and small ones, especially when the latter are operated at low pressure. Probably the feature most effective in raising the distribution efficiency in Chicago to the remarkably high figure of very nearly 90 per cent is the very large proportion of railway load carried always in a few points and in very large amounts. Berlin, with a traction load of less than one-third the total, also

shows an efficiency of distribution hardly better than that of London. Chicago has the phenomenal load-factor of 41 per cent, Berlin 33.1, and London 24.9. In Berlin, in spite of a rather stiff municipal participation in the profits, the net profit on the capital is greater by 2 per cent than that in Chicago, no large traction load having been taken on at very low figures. The fuel cost per kilowatt-hour in Berlin is double that in Chicago and outweighs tenfold the difference in wages cost. In fact, an analysis of the respective costs in these two cities leaves some doubt in one's mind as to how far it really pays as an earning proposition to take on large loads at low rates. It does help the load-factor and the efficiency of distribution, to say nothing of greatly increasing the total receipts, but it seems to pull down the average price per kilowatt-hour to an extent that, temporarily at least, outweighs the other advantages from the standpoint of net earnings per dollar of real money invested.

Professor Klingenberg took up seriously the problem of helping out London by bulk from large stations and showed, of course, the inevitable large gains. Yet, considering the very low costs reached in some of the London plants, it may be an open question whether a group system based on improvements on present practice might not yield better profits by lessening the great cost of the complete revision of so great a number of individual systems. The most efficient of the London plants compare well with anything in the business.

Railroad Electrification

The former and present views of Mr. B. J. Arnold on the electric-railway situation, outlined in this issue, furnish a striking example of the cautious foresight of the skilled engineer. Indeed, things have turned out, or rather have not turned out, much according to his shrewd prophecy of nine years ago. At that time, to glance at the situation in review, it was perfectly clear that from an engineering standpoint electrification of terminals or even main lines was perfectly feasible and that in many cases it would give promise of no inconsiderable economies. To those who, like Mr. Arnold, knew something of the practice of railroading from the inside it was equally evident that most roads would not take up electric service except under compulsion, save in the most unusual circumstances. Electrification means a large investment in real money, which is a hindrance to the wonted dividends, particularly when the borrowing power has already been seriously impaired by various feats of finance. Hence it turned out, even as Mr. Arnold predicted, that while in certain directions there was large activity, progress in general electrification was slow. Terminals and tunnels have been, by force of law or public opinion, re-designed for the newer motive power, but it is only recently that steps have been taken to inaugurate the larger enterprises. As Mr. Arnold truly says, the whole matter to-day is one of economics, and we are sorry to say that in the present state of railway affairs the prospect of improvements which mean increased capital charges is rather remote even when there is good prospect of saving in operating charges.

On the engineering side of the matter there is no fear of failure by any of the methods that have been used here and abroad. If the harmonious co-operation between roads of which Mr. Arnold speaks can be brought about, great benefits in terminal facilities will surely follow, and the way will be open for extensions into trunk-line service. Yet such co-operation implies heavy initial expense with the accompanying difficulties and will have to come slowly.

Perhaps the most striking part of Mr. Arnold's discussion is that devoted to the mutual relation between cities and transportation companies. His suggestions sound somewhat more radical than they really are. With the present trend of public opinion, the public authorities are absolutely certain to take an increasingly strong hand in the administration of public utilities, and perhaps it is wise thus to recognize the situation at the start rather than to wait in a state of nervous tension for it to take what will inevitably be its future form. If one could start *de novo* with a transportation system in a large city, the task of arranging suitable reciprocal relations with the municipality would be comparatively easy. Unhappily such a case is quite beyond possibility, and the actual situation is greatly complicated. The fundamental difficulty is to determine that fair value of the property on which every reasonable man agrees that a fair return should be allowed.

It is perfectly well known that there always has been a strong tendency to capitalize on the probable future earning capacity of the property rather than on the physical valuation, however liberally construed. It is equally well known that in most cases necessary renewals, and indeed successive mistakes, in equipment have usually been met by increase in capitalization rather than by suitable provision from the earnings. In plain terms the dividends have been in no small part taken out of the property, trusting, not without reason, that the increasing value of the traffic would allow the real deficit to be hidden behind a new bond issue. It is perhaps for this reason that Mr. Arnold recommends that the city or state should supervise not only the capital expenditure but also the operation of the property. The remedy seems to us drastic, but perhaps it is necessary. It seems that it might be sufficient to hold such grip on the administration as would prevent the payment of dividends until sinking fund provision had been made sufficient to maintain permanently the then physical value of the investment. If the issue of new securities were limited to the purpose of legitimate extensions at their actual cost, there would be little complaint about compelling the public to pay dividends on watered stock. It is always a question whether control of operation would prove efficient in the present state of political morality, while the limitation of new issues of securities and the enforcement of proper reserves are things comparatively easy to enforce.

Electrical Industrial Growth in 1913

By T. C. Martin

THERE will no doubt be found some hardy and irrepressible spirits ready to sing the glories of 1913, but probably few will be recruited into that optimistic chorus from the ranks of electricity. Other fields of human endeavor in these United States may be more jubilant, but even that is open to question. Perhaps there is nothing better than taking your own medicine, and it is beyond denial that for many years past the electrical arts have been beyond all others those most provocative of and insistent upon change and progress. Let the accent be heavier on change than on progress, because it is still open to argument in socialistic quarters that Kelvin, Faraday, Morse, Edison and a few others are enemies of the human race in bringing to it new gifts, speeding it up, summoning it to higher efficiencies and economies. At least, we electricals have been introducing real change. More than that no "progressive" can claim; political or otherwise. And if we wanted to stop the advance we should not know how to do it.

In a year when practically all that is best in American enterprise, effort, activity and individualistic struggle toward better conditions has been under chill, repression and disaster, the many arts electrical, shaped wholly by human wants and necessities, have lifted themselves to higher levels. If those levels have on them, like milestones, the dollar mark of accreting totals, it may be unfortunate in days when to increase the wealth of the race is a crime. But it cannot be helped. It can only be cured by the abandonment of all that has gone before in uplift.

Commercial Advance

It is here proposed to size up electrical advance by the dollar yardstick. Others can rightly take the scientific or the inventive aspects, but it all gets down to the benefit that can be derived by humanity in the mass; for not even the abstruse metaphysician lives to himself alone, although his affinity may be some star millions of years away. In all electrical developments we have to deal with the impress made on average utilization and consumption with the appliances at command to replace old forms of apparatus or lure people to the use of new comforts and conveniences. Fortunately, in America we have a population which has come here chiefly to escape from the Old World habitude of self-denial and have a good time, so that what is saved on armaments can be "blown in" on armatures and their output. It is at least significant that the average expenditure of the public in this country on electrical service is some five or six times what it is in any European country with a respectable claim to be more civilized than we are. Which raises the fair question as to whether the highest use of electricity is not civilization at its best. Certain it is that electricity has played a vital part in the progress of civilized communities.

For several years the *Electrical World* has tried to sum up the general advance in the field for which as a whole its name is a sufficient warrant, and the present writer has as editor frequently done for it in that respect what he now does as a "looker on in Venice," with a very keen special interest in the traffic on the Grand Canal of electric light and power. Some figures are now submitted which are entitled to the "E. & O. E." inscription of every careful bookkeeper's statement and must be taken for what they are worth. It has been customary to take six or seven grand divisions of industrial electricity and to present estimates of the value of their output or their service to the public, the total thus standing concretely for the extent to which electricity is used in the United States. Conversely such figures give some measure also of the extent to which we fall short of "saturation," and that again affords some indication of the opportunities ahead of everybody in the electrical industry.

Rate of Increase

Obviously, it is essential to base such estimates on established data or fairly well-proved rates of growth, and the figures here presented have at least that merit. For example, the United States Census Bureau has recently issued its report on electrical manufacturing for 1909, giving a total of $221,000,000 of product valued at the factory, and showing as compared with 1904, when the amount was $140,000,000, an average gain of 10 per cent per annum for the five years. The same ratios would give a total for 1913 somewhere around $310,000,000, whereas the estimate presented for 1912 in these columns last year was $350,000,000. But the census figures do not include any of the enormous production of poles and cross-arms, iron and steel towers for transmission lines, glassware and porcelain ware made specially for electrical purposes, bare iron and copper wire drawn to be suspended on all these supports.

Then, too, in the broadening domains of electrochemistry and electro-metallurgy no credit comes to electricity in the government figures, which, in export trade, even put electric locomotives in a class with which it is generally supposed electricity has nothing to do. In like manner the 30,000 tons or 40,000 tons of electric steel—there were 29,105 in 1911—as well as all the electrolytic copper, are counted into the statistics of the steel and copper industries. Even an electric automobile belongs to the vehicle industry. Hence the difficulty of making comparisons year by year. But with a definitely known output of strictly electrical apparatus of about $310,000,000 in 1912, it should be moderate to place the total in 1913, inclusive of some proportion of the factors just named above, at the impressive total of $400,000,000.

In some branches of electrical manufacturing there was serious stagnation, but one leading expert, to whom an output of $100,000,000 is normal, writes: "I should say that a gain of 10 per cent in the electrical apparatus business is fair for this year. Of course, you understand that the latter part of the year does not show this gain, while the early part of the year might show more."

Electric Railways

The greatest department of electrical earnings is that of street railways, and the total in this field was placed last year for 1912 at $625,000,000, or less than 10 per cent over the previous year. Statistics extending over a long term of years would seem to indicate an average gain of 7 per cent or 8 per cent in gross, but this is complicated to some extent by the increasing volume of earnings in electric service on main steam lines in zones of rapid expansion. Assuming that the figure of 1912 was near the mark, it would be conservative to apply a gain of 5 per cent to the total, making at least $650,000,000. One authority who studies such figures as closely as anybody in the world is inclined to put the

gain for the year at 6 per cent, which gives us somewhere around $675,000,000.

Central Stations

The central-station field is most difficult to estimate or bring to book. It seems almost impossible that an industry well-nigh fifty years old dating from its first arc lamps, or forty from its first incandescent, could go on increasing for two decades at the rate of 15 per cent or 20 per cent per annum. But one cannot deny hard facts, and it might be argued from them that the modern central station, in getting closer and closer to the human needs of the time, has at last discovered the secret of eternal youth. The available and authentic statistics show that without going back of 1902, when a higher rate of "getting there" may have prevailed, the gross earnings of the industry rose from $85,000,000 in that year to nearly $176,000,000 in 1907. That is somewhat better than 20 per cent gain per year, or more than doubling every five years. The Census Office has recently made public some of its earliest figures for the central-station industry in 1912, marking the five-year period, and it is almost startling to see how the 15 per cent or 20 per cent rate of growth is maintained. The older the State the less likely is a gain because of the pre-established conditions, but it is significant to note that in Vermont in ten years the gain has been 140 per cent and in snug little Rhode Island 124 per cent, and then you get a jolt in learning that Connecticut shows 305 per cent. Wonder if Dunham had anything to do with it? New Mexico and South Dakota cannot show much more, although Idaho looms up with 725 per cent again.

It will be admitted by anyone that there is something not quite normal when the central-station industry can show an average increase at least twice as great as that in the street-railway field, and there is the suggestion of enormous possibilities in both directions. Undoubtedly the American public is under-supplied with transportation, but just so long as the humble investor is told to keep out the congestion in street-car service will remain and our only standing room will be each other's toes. In the central-station field it might be supposed that over-stimulation had done its deadly work, but when one of the foremost authorities in the world, operating in Chicago, says that the system there is barely half-way to its goal of universal service, the inference can only be that increments of 15 per cent and 20 per cent are likely to be maintained these many years to come. The Society for Electrical Development has a plainer mission than even its most sanguine advocates dreamed of.

It will be recognized that a large estimate of growth must be put even in an off year on central-station advance, and that a figure of 15 per cent is within bounds. For the year 1907 no less than $176,000,000 was shown. This would give over $350,000,000 for 1912. A 20 per cent increase would give $420,000,000 for 1913. It has been closely calculated by various authorities that an output valued at $450,000,000 is nearer the mark, but that was the total assigned in this estimate last year. Probably no one will dispute, therefore, the intention of leaving it just there.

Telephony

The largest field of electrical development after electric railway and central-station work is telephony. Here, again, the art suffers from the lack of recent figures, but there are some data at hand. The gross earnings of the Bell system in 1912 reached the amount of just about $200,000,000. During the excitement and agitation of the last month or two, when the government in its efforts to crowd the Bell people to the wall announced through various mouthpieces that it intended to go into the talking business, President Vail, to reassure the panic-stricken stockholders, stated that the system had gained some $14,000,000 in ten months. This would be at the rate of at least $15,000,000 for the year, or about 8 per cent. As a matter of fact, the telephone industry would be falling short if it did not reach 10 per cent. The only question that remains is how far the independent systems have kept pace. At one time it was reasonably safe to credit them with a total not far below that of the Bell system, but to-day such an estimate looks rather exaggerated. If, therefore, the total were left at the figure of last year, $350,000,000, no one could complain that it was much out of the way.

Isolated Plants

There are no signs or evidences that isolated-plant service is increasing in these days, except in marine work, in some large steel plants, or in factories remote from central-station sources of supply. Hence the figure of $125,000,000 cited for 1911 and 1912 cannot be far out of the way for 1913. The same is true of telegraphy, and of miscellaneous electric service with such endless variety that nearly 1000 manufacturers are required to cover it. Much of this product now goes into an export trade of $25,000,000 a year, which could be increased with an intenser effort to market it.

Summary

A table is presented herewith bringing out the above figures. Last year, after the general activity of 1912, an estimate was made that came out slightly in excess of $2,100,000,000. While, on the whole, 1913 was such a blue and disappointing year, it is felt that no great error will be made in submitting the total of $2,160,000,000 as one that probably hits pretty close to the real mark.

As to the near future, all the indications are those of rapid advance. Mr. Frank A. Vanderlip, the great banking authority, has pointed out that the central-station industry alone requires about $180,000,000 of new capital annually, and has estimated that the allied industries call, with it, for about $400,000,000, or, roughly, $8,000,000 per week. Such floods of money are forthcoming, but must be invited by reasonable reward; and thus the total of gross earnings is forever carried forward, the investor receiving a very modest return for his upbuilding of the industry and the benefits it confers on the entire community. Few fields have been more susceptible and sensitive to the restrictions placed upon them of late years by repressive legislation than the electrical; few will respond more quickly to a loosening of the trammels and an invitation to advance and become more useful to the public. In hydroelectric development and energy transmission alone the opportunity and demand exist for work utterly beyond anything heretofore attempted or done, but the man who risks timidly a dollar in it will not hazard it without a better prospect of getting it back with a buffalo nickel added than he has had in the past.

DATA ON GROSS INCOME OF ELECTRICAL INDUSTRIES, 1913

Electrical manufacturing	$375,000,000
Electric railways	650,000,000
Central stations	450,000,000
Telephone service	350,000,000
Telegraph service	85,000,000
Isolated plants	125,000,000
Miscellaneous	125,000,000
	$2,160,000,000

Applied Electrical Science in 1913

By A. E. Kennelly

THERE are so many branches of electrical science and so many ramifications of its applications that no single presentation of opinion concerning the progress of electrical science during a single year can be expected to cover more than a portion of the entire field. If, as is claimed by some electromagneticians, the whole subject of radiation—luminous as well as non-luminous—is nothing but a by-product of electromagnetism, and if, again, as some contend, all matter is composed of electrons—so that inertia and gravitation are merely little incidents of electromagnetic action, while all of chemistry is but another aspect of the same general electric activity—it is evident that there would be hardly anything left to consider in the universe, as yet known, after electricity had been thoroughly discussed, and one would be reminded of Mark Twain's friend in Italy, who begged his guide to sum up the disclosures of the preceding week by announcing that the Almighty had made Italy from designs by Michael Angelo!

There have been, however, noteworthy advances in electrical science during 1913, even under a modest interpretation of the scope of that science from the standpoint of electrical engineering. These advances may be classified, for the purpose of discussion, as relating to theory, to application and to convention.

Roentgen Rays

In regard to theory, the most remarkable step, perhaps, has been the general admission of the conclusions derived from experiment, that Roentgen rays have wave-length and are capable of being reflected, besides being susceptible of interference. The wave-length of visible light appears to be thousands of times as great as the wave-length of Roentgen rays. This inference as to the existence of Roentgen wave-trains opens up a wide field for the investigation of ultra-microscopic structures with the aid of photography. That is to say, light fails to reveal structures that are of small dimensions by comparison with 1 micron, because the waves of light are too long for the purpose. Although we cannot see Roentgen rays directly, yet, their wave-length being so small they can be made to penetrate very minute molecular structures and then to reveal their condition, as affected by such penetration, upon a photographic plate. Already some beautiful photographs have been secured of Roentgen rays, after having been filtered though a thin crystalline plate, revealing an orderly pattern of lights and shadows. The analysis and interpretation of such large-scale patterns in terms of what occurs in transit through the crystal calls, however, for much experimental and mathematical investigation.

Electronic Theory

Good progress has also been made in the investigation of the electronic theory of matter toward elucidating stable kinetic groups of electrons. Electric models of chemical atoms are still matters for the future, but suggestions as to the framework of such models begin to take provisional form. Until recently discussion has been directed as to whether the existence of individual electrons could be taken as proved. Now there appears to be no serious protest raised in any quarter against the existence of the electron as a natural unit of electricity, and discussion has more recently been directed to the properties that can rightly be considered inherent in electron groups.

Oscillations

Good progress has also been made in the experimental and mathematical study of electric oscillations over conducting circuits. This progress has been stimulated by inquiries in the radio-telegraphic field. That is to say, the need for more engineering knowledge in regard to the best expenditure of money in radio-telegraphic systems has distinctly accelerated scientific inquiry into the general subject of wave transmission. It looks as though in future a more sharp division would exist between the provinces of knowledge for high-frequency and low-frequency workers than has ever yet separated high-tension and low-tension workers or strong-current and weak-current workers.

Illuminants

In regard to applications, a distinct advance has been made in incandescent lamps of large luminous output and small electric power consumption by the application of laws but recently experimentally established concerning the convection of heat in gases. The improvement gained with such lamps, containing gas at a very respectable pressure, indicates how much caution is necessary in generalizations to the effect that because a device like the incandescent lamp has for years been manufactured in enormous numbers with evacuated globes no hope could be entertained for the success of a lamp which did not employ an evacuated chamber. One is reminded that in mediæval times the ordinary water suction pump was commonly supposed to operate for the reason that Nature abhorred a vacuum, the notion of atmospheric pressure not then having come into recognition. Galileo, however, remarked that such generalizations were dangerous, since Nature seemed to stop abhorring a vacuum when it was attempted to work the suction pump beyond a lift of 32 ft.

Radio Communication

Further improvements have been marked during the year in the application of relatively large dynamo machines to the production of alternating currents of sufficient frequency to excite radio-telegraphic sending mast-wires to full resonant oscillation.

Not only has the range of effective radio-telegraphy been distinctly increased during the year, but radio-telegraphy has also been applied to regular time-signaling as well as to transatlantic longitude determinations. Twelve hours out of the twenty-four are now signalized by the emission of official time signals, in accordance with a definite international schedule. A special experimental radio station, near Brussels, has also been brought into action for the study of attenuation of signals at various distances, times and seasons. It is remarkable that the Atlantic Ocean, which it took Christopher Columbus ten weeks of anxiety and doubt to cross in 1492, should now, in the regular course of business, be constantly crossed by radio-telegraphic signals in about the fiftieth of a second.

In regard to the determination of difference in longitude between distant stations with the aid of radio-telegraphy, the reported degree of precision attained is already so considerable that the possibility is suggested of being able eventually to detect in this manner small longitudinal distortions in the terrestrial globe. That is to say, careful measurements of latitude, continued at several observatories, have indicated in recent years that the pole is peripatetic, or that the axis of the earth shifts over what might be called a hectare-lot, so that a

stake driven into the mountains of the south pole, truly designating the position of the earth's axis, would have to be moved slowly and steadily from day to day—or even, for greater precision, from hour to hour—within a certain range of total deviation. So careful measurements of longitude, with the aid of radio-telegraphy, might reveal small disturbances in longitude of the earth's crust.

Distinct progress has also been reported during the year in the development of current amplifiers, especially in connection with radio-telegraphic receivers.

International Co-operation

With regard to conventions in electrical science the cause of international standardization made marked advance during the year 1913. The New York midwinter convention of the American Institute of Electrical Engineers, held for the purpose of discussing changes in that Institute's standardization rules, elicited a large amount of valuable experimental and technical material, indicating in itself how much scientific knowledge is sought and found in the quest of a proper basis for industrial standards. This was followed by certain international sub-committee meetings of the International Electrotechnical Commission in Europe, which, in their turn, were again followed by a meeting of the International Electrotechnical Commission as a whole in Berlin. Distinct advances toward international standardization were made at that meeting along the lines of uniform copper-wire tables, uniform machinery ratings, uniform nomenclature and uniform electrotechnical symbology. It is clear that no ill luck has attended the year 1913 in regard to international electrotechnical convention. International commissions were also successfully convened in relation to illumination at Berlin and to physico-chemical symbology at Brussels. Slowly, with the aid of intelligent good will, in spite of the constant menace of arms and warlike preparations, science, through electric telegraphy, fast ships and rapid communications, tends to undo the harm which many past centuries effected in the separation of the desires and ideals of men by mountains, seas and deviations in language. It is true that international commerce and international communication tend to keep the world's good will, but what may not also be said, in this connection, for the international volt, ohm and ampere?

Another distinct advance toward simplicity and uniformity of international relations has been in the adoption this year in the custom houses of all the leading nations of the world, including Great Britain and the United States, of the metric carat of 200 milligrams for the weighing of jewels and precious stones, thus helping to introduce the metric system which underlies all modern science as well as the ohm, volt and ampere.

Regulation from the Telephone Viewpoint

By Theodore N. Vail

WHILE regulation by commission is now a recognized policy of our government, it is still important to bear in mind that in order to be permanently successful regulation must be effective. The legal machinery for effective regulation has been created. The controllers of the machinery are the men chosen to execute the laws. If wise men are not appointed or elected the laws will not be administered properly. If the commissioners have not sufficient ability or breadth of mind to understand clearly the problems before them, they will fail to satisfy the various elements composing the public. If their work does not attract and hold public respect, it cannot be effective.

Regulation Should Be Effective

Because a wise form of control of operations and rates will protect properties as well as the consuming public, it is the duty of managers of public utility corporations to try to make regulation effective. If, however, regulation is to be effective it must be fair. It should be so fair that the justice of it will be recognized by both the corporation and the consuming public. Men of ability and strength of character will be likely to want to follow this course. In order to do so, they will have to resist public clamor at times and undue demands from corporations at other times.

Commissions can never become effective unless the matters over which they are supposed to have jurisdiction are left to them and not taken out of their hands by self-constituted public committees or even by legislative committees. The object of a commission is to obtain deliberate action and gather facts and conditions that cannot be obtained by a temporary committee, and also to establish a body of permanent record and to establish precedent.

There is still room for education on the part of the public and corporation managers as to the best disposition of the problems arising from their relations. Both, however, realize now that a form of regulation is the most promising method of developing the relations that should govern their transactions. Neither one should expect more than he ought to have. Some of the old bargains were closed after long negotiation in which each side showed plainly its belief that if it wanted to get one foot of advantage it was necessary to ask for a mile. Those times have passed. Regulation is not a synonym for trading. It should be on the highest plane. It should develop standards of equity so well recognized that the country would manifestly progress under them.

Fair Rate of Return Essential

A corporation fairly entitled to a return of 10 per cent on its investment in a certain locality should not have to go into court and ask for 15 per cent in order to accept, apparently as a compromise, the 10 per cent to which it is reasonably entitled. If the public wants a rate of, say, $1 for gas now costing $1.25 and it is fairly entitled to some reduction, it ought not to have to ask a rate of 75 cents and accept the rate which it justly should have as an apparently unsatisfactory compromise. The more equitable the rules are the more contented the litigants will be likely to be. If there is a fair question concerning the adequacy of rates or their excessiveness, it is to the ultimate interest of all parties to settle it, if possible, without rancor. Certainly the issue involved in such a case is plain. The company needs a revenue large enough to meet all of its expenses, including depreciation, its taxes and charges and a fair return on the investment. Unless, however, it has a margin above these necessay outlays sufficient to give evidence to bankers of a reasonable certainty of a continuation of enough revenue to meet all of them without default, it will have difficulty in raising capital for extensions.

The ways in which the public and the companies can promote the effectiveness of public regulation vary in

different localities. Every effort should be made on both sides to secure commissioners of ability and fairness who will administer the laws that ought to be enforced.

Every effort that is made to put men of less satisfactory kind on commissions will tend to nullify the spirit of regulation and will harm both the public and the companies. If the commissioners are able and are earnestly trying to do their best to solve fairly the problems before them, the public and the companies should uphold their hands.

While the complexity of the telephone industry makes it a difficult subject of regulation, yet it has advocated and seeks full public control. This is done with a confidence in the ultimate fairness of the public and a belief that regulation will help to perpetuate the co-operative relations that should prevail between the public utilities and their customers.

Risk and Public Service Control

By Robert H. Whitten

IT is an interesting fact that in the general upward trend of prices since 1896 public utility services and products have grown steadily cheaper. While the prices of labor, materials and products have increased tremendously and the cost of living has been going up and up, the price of gas and electric light and the price also of street railway and telephone service, if measured by absolute amount and quality, have shown an almost continuous decline. The greatest advance in prices has been in the case of crude farm products and products of the forest. In the case of articles the price of which depends most completely upon the costs of manufacture the increase has been comparatively small. But while the price even in the case of manufactured products has increased to a considerable extent the rates of charge for services supplied by municipal monopolies have in general declined.

In Massachusetts the average price of gas decreased 47½ per cent between 1886 and 1910. It is estimated that the average price of electric light per kilowatt-hour in Massachusetts cities decreased 48 per cent between 1890 and 1910. While in the case of street railway transportation there has been a quite uniform 5-cent fare, and while during the past few years there has been a tendency to increase the cost of city transportation by curtailing transfers and establishing fare zones, the general trend has been decidedly downward if we take into consideration the possible length of ride and the great improvement in the quality of the service rendered. In general we know that the small, poorly heated and lighted horse car has been superseded by a more commodious, better lighted and heated electric surface car, and this, to a considerable extent, by the more comfortable and much more rapid elevated and subway car. We know also that at first the surface lines radiated 2 or 3 miles from the city center and that now they may radiate 6, 10 or even 15 miles from the center.

Monopoly Versus Competition

The above comparison furnishes abundant justification for a régime of virtual monopoly as opposed to competition, as applied to the above public utility services. The favorable showing of virtual monopoly is due to reduced capital expenditures, reduced operating costs and, more important still, reduced risk.

Public service regulation is a recognition by the state of the essentially monopolistic character of these enterprises. The power of the state to regulate rests largely upon their character as virtual monopolies. A virtual monopoly of the supply of any commodity or service that is important to the welfare of any considerable portion of the community is a delegation of sovereignty. Any corporation in which monopoly is vested is an agent of the sovereign, the state. This monopoly exercises governmental functions, and such a delegation of governmental power is only conceivable on the theory that it is accompanied by a well-defined and effective responsibility to governmental authority.

Efficient public service regulation will make possible further reductions in the cost of production of public utility services. This will come chiefly through its influence on the element of risk. Risk is one of the most important elements in the present cost of such services. If risk could be abolished and the capital charges reduced to a pure interest basis, it is evident that the cost of production would be very greatly reduced. Risk cannot be abolished, but, by effective safeguards and a well-considered policy of public control, it can be greatly reduced.

Uniform Accounting

A distinctive feature that characterizes recent public service regulation is the requirement of uniform accounting. Uniform accounting constitutes the greatest advance toward a scientific and efficient system of public service control. An even more recent development is the exercise of control of security issues. Such control is essential to correct accounting. A chief purpose is to show how much money actually goes into the property. The control of security issues may be used to supplement the accounting control by requiring in certain cases a rewriting of the books of the company as a condition to an approval of a new issue of securities, in order that the books may more truly represent the condition of the company.

A merely nominal control over accounts and capitalization is worse than useless, as it gives the investor a false confidence in the accounts and securities of the company. If, however, the control is efficient, it will result in great benefit to the companies, the investors and the public. To the extent that such control reduces the risk that the investor runs in purchasing securities it will necessarily reduce the cost of financing, the permanent capital charges, and hence the total cost of producing the service.

Risk and Profit

The possibility of adequate profits is not in itself sufficient to reduce the risk of public utility enterprises. In the street railway industry we know that in the past the assumption of large profits, instead of reducing risk, served largely to increase the investor's risk. The supposed profits furnished the excuse for the payment of exorbitant rentals and the capitalization of supposed earning power, resulting in the bankruptcy of the systems. The resulting loss to investors inevitably increased their conception of the risks of the street railway enterprise and hence increased the rate of return required to sell street railway securities.

Another way to reduce risks and safeguard the investment is to build up a liberal reserve and use it in making necessary improvements and betterments. This will reduce the proportion of property value represented by outstanding securities. The increasing value back of the securities will make them an increasingly safe investment. The rate-paying public can well afford to bear the temporary extra cost of reserve building, provided the reserve which they contribute is not made to earn added dividends for the stockholders but is used, first, to safeguard a fair return on the actual investment of the security holders and, second, to reduce the cost of production and the rate of charge.

Methods of Regulation

But under present laws and methods of rate regulation there is nothing to insure that additional revenues allowed for the purpose of building up a liberal reserve will be so used, or if so used that they will not be made the basis for excessive dividends. The companies claim a fair return on all their property, even though a considerable proportion of it has been constructed out of earnings. It is unreasonable to expect the rate-paying public to furnish the capital for improvements and then pay interest and profits on the capital so furnished. If divisible profits could be strictly and continuously limited to a fair return on the money actually contributed by the security holders, there would be no doubt that a conservative policy of making improvements out of earnings would inure to the permanent good of the consumers, the shareholders and the industry as a whole. Without a direct limitation of profits, however, the making of improvements out of earnings often results in a temporary concealment of exorbitant profits, awaiting the time when they can be prudently distributed to the shareholders.

Control of Profits

A direct control of profits seems the logical method of attacking the problem of rate regulation. What is a fair price as between buyer and seller in the case of a monopolized article is usually a question of what constitutes a fair profit for the service rendered. It is in general easier to decide what is a fair profit than to decide what particular rate schedule will exactly produce such profit. In a rate regulation proceeding there are so many factors that are not susceptible of accurate determination that the result must be largely vitiated. If profits are strictly regulated, rates of charge will ordinarily take care of themselves. Rate regulation may then be confined to a prevention of discrimination, and the necessity for even this degree of interference will be largely obviated.

Rewards Based on Efficiency

A system of public service regulation based on a continuous control over divisible profits would also have the advantage of permitting the reward of different companies according to their comparative efficiency in serving the public. Under our present system of occasional rate regulation the tendency is to allow the same return regardless of efficiency. This tends to kill the incentive for efficiency. Of course, it would be possible for the commission in determining what is a "fair return" to take comparative efficiency into consideration. It could have a certain scale of rates of return that it would apply to the various companies according as they stood high or low in comparative efficiency and in the cost of the service they were rendering the public. This, if carried out systematically, would doubtless have certain advantages over the present method, which appears to aim at limiting the company to what is practically a uniform rate of return. The chief difficulty with this plan, however, is that there is no control over the actual profits distributed between the times when the rate-fixing process is exercised. Between these rate-fixing times the company may, and probably will, pay out profits in excess of those that have been determined as "fair" in view of the comparative efficiency of the company's service. This is a fundamental weakness. If it is proposed to reward efficiency with a rate of profit higher than the ordinary, this rate should not be exceeded until such time as increased comparative efficiency would warrant a higher rate of return. There must be a continuous control over the amount of profits that may be distributed in order that a control based on comparative efficiency may be really effective.

Influence of the Holding Company on Electric Utilities

By A. K. Baylor

IN reviewing the growth of electric public service in the United States during recent years, attention is especially attracted to the increasing extent to which outlying districts and communities with small populations are being served.

Modern improvements in high-tension apparatus and transmission appliances have made possible the construction of long-distance lines that a few years ago would have been impracticable on the score of both reliability and cost. As a result, mere villages that could not support any sort of independent central station, and towns formerly inefficiently served, are enjoying high-class electric service from such transmission lines, energy being conveyed into remote and rural districts for mining, farming, ice production, irrigation or industrial work.

The Countryside Network

It appears reasonable to predict that in a few years all sections having substantial populations will be served by networks of transmission lines and the fullest benefits of the principle of infinite subdivision of electric energy, first developed by Mr. Edison for incandescent lighting and now the foundation of modern electric power supply, will be realized.

It is obvious that central stations of relatively small capacities operating within confined territorial limits cannot give the public these benefits, and that many outlying districts cannot be properly served at all, unless their requirements form parts of a combined load, with the larger centers of population as a basis.

The Holding Company as a Factor

In addition, however, to engineering progress and invention, another factor has been at work in bringing about the present conditions under which a large and rapidly increasing proportion of the general public are being served with reliable and cheap electric energy. This factor, which is one of the most important phases of the electric industry at this time, is the holding company.

The economy of bringing together under one juris-

diction the management of a number of separate properties is generally regarded as the chief advantage of holding companies and the principal justification for their existence. The standard of high-class service that is now so generally established in the United States, the benefits of the best technical and expert advice applied even to the smallest central-station, substation or distributing system, the cumulative effect of active up-to-date new-business campaigns at every point, all resulting in improved and cheaper service to the consumers, are directly attributable to centralized control and operation, and without the facilities of such a system they could exist only in the larger communities.

The economies due to central management, while of very great importance, are by no means the only advantages of the holding company system. Back of all such considerations lies the great problem of financing these undertakings. Before economy in operation, engineering supervision or new-business development comes within the range of practical politics, the central station, transmission lines, distributing system and other machinery of service must be created. In providing financial facilities for these purposes the holding company performs its most important function. In fact, the need for such facilities to meet the growing demands of the public for electric service called the holding companies into existence, their creation being due more to financial necessity than to practical or economic advantage.

New Issues of Capital

It is estimated that new capital at the rate of about $8,000,000 a week—$400,000,000 a year—for several years to come will be required, if present progress is to continue. It must be obvious that such sums can be attracted only by securities having not only a nation-wide but an international market.

For every dollar of new annual revenue a capital expenditure of approximately five dollars must be made by electric utility companies in central-station plants, distribution systems and service connections. The natural growth of existing services plus the demand of fresh fields to be served is so great that even if the total revenue from operation of existing systems were applied to extensions without payment of any interest or dividends whatever, still such extensions would be totally inadequate to meet the public demands for service. New investments of capital on a large scale must, therefore, be made in order properly to supply these demands.

To carry out such a financial program, the issues must be large and backed by a high diversity factor. It is exactly these characteristics that the holding company makes possible.

The difficulties met with in financing a project to serve a new community on account of the small size of the issue, the fact that it is based on prospective and not on established earnings, with the disadvantage of a localized risk, largely disappear when such an undertaking is made part of a large issue based on substantial existing earnings with a diversified risk spread over many properties in different localities.

Difficulties in Financing

In some cases groups of established properties may enjoy the benefits of joint operation without the existence of a holding company by being absorbed into a single stock issue of the parent company, but in general this can only be done when all the subsidiary companies are contained within the boundaries of the same state and when the parent company owns outright all such subsidiaries.

Most of the holding companies, however, control properties in different states, and their subsidiaries must be independently incorporated so that as domestic corporations each may perform its functions in the community served. Furthermore, many properties now enjoying the financial, engineering and commercial advantages of holding company membership are not owned entirely by the central organization.

The holding company system has proved itself to be effective in meeting the requirements of the great problem of financing electric public service, and the facilities provided by such companies are more necessary now than ever before in order to maintain existing services, meet the demands of natural growth and provide for new developments. Subject to proper regulation, the holding company in this field has been and is an unqualified public benefit.

Another product of electric public utility development is the bringing of these industries under the jurisdiction of public service commissions, which are as natural an outcome of modern conditions and public necessity as are the holding companies. There is fortunately good reason to expect that the establishment of the commissions in the various states will generally abate and in many instances entirely remove friction and mutual distrust between public service companies and the political authorities and public of the communities served. Generally these commissions, although often made up of men not previously schooled in matters of public service, have shown a disposition to be fair and equitable in their regulations when they have come face to face with the practical conditions they have to deal with.

Commission Regulation

Numerous applications for authority to compete in districts already well served have called forth from the Oregon Public Utilities Commission the following statement:

"One company properly regulated and administered can generally give better and cheaper service than two. It is a waste of capital and a disadvantage to a city to have two sets of telephone and electric-light wires and poles cumbering the streets when one can be made to serve the same purpose. Most utilities are natural monopolies, and the highest efficiency and lowest rates are possible only when each one has the entire business of a given city or territory. Now that we have the right and duty to regulate all public service corporations, the ill effects of monopoly may be escaped and at the same time the beneficial results of economy and efficiency realized."

A similar attitude has been adopted by other state commissions, notably those of Wisconsin and California. Public utility operators have little to fear from the regulations of a body of officials standing on such a platform.

The stronger elements engaged in the electrical service field should devote themselves to a campaign of education of the public at large, the municipal authorities and public service commissioners. Moreover, they should use every proper means at their command to discourage unsound developments and over-capitalization calculated to discredit the industry as a whole and adopt a policy of the greatest possible liberality in dealing with municipalities in connection with the supply of energy for street lighting and the pumping of water for public uses and for all other purposes that are universally recognized as being within the legitimate scope of municipal control and regulation.

Under these conditions, with a full understanding by the public of the nature of holding companies and the benefits that accrue from their operation under fair and reasonable regulation, such companies and the electrical utilities they control and operate will undoubtedly enjoy popular confidence, appreciation and support.

Relative Stability of Public Utility Financing

By W. W. Freeman

AN increasing appreciation on the part of the conservative investing public of the stability and attractiveness of public utility investments has been clearly noticeable in recent years. It is a well-known fact that capital is timid regarding unseasoned investments, or those of speculative rather than stable earning capacity; therefore preference is given to securities which are regarded as standard, even though their earning capacity may be less than others which possess ample security but which are not so well known and therefore not so highly regarded.

For some time past bankers and investment brokers have appreciated the fact that public utility companies possess advantages in growth and stability of business which entitle their securities to be classed among the best, and this fact is becoming better understood from day to day by the individual investor.

Among the considerations which lend stability to the public utility securities, the following are worthy of special recognition:

Management

The continued success of a public utility company in any city of reasonable size is merely a matter of proper management, as the elements which are essential to growth and success are to be found in practically every such city to-day. The public is dependent in large measure upon such utilities for its own convenience and welfare and is, with few extreme exceptions, willing to pay a reasonable price for the service, and even in such extreme cases the company is protected against confiscation by the courts. Entirely aside from the growth of the community, no utility company has as yet reached the saturation point of the present population, and the normal future growth furnishes ample assurance of steadily increasing revenue.

The management of these companies has become reduced practically to a science, and through the activities of the various associations covering the street railway, gas and electric industries the combined knowledge and varied experience of the art are at the individual service of every company manager, if he chooses to avail himself thereof. There is less dependence, therefore, upon the human equation with the average manager than in any other field of industry.

Monopoly

A further protection is afforded in the growing and now generally accepted theory that these public utilities are best operated for the public interest in the form of regulated monopolies, thereby guaranteeing to the public, on the one hand, the reduced expenses made possible by the elimination of duplicate investment and by increased efficiency of operation, and, on the other hand, protection against unreasonable charges or conduct on the part of the utility company. The advantages of regulated monopoly are so apparent that the public service commissions in many of the most prominent states are already committed to the policy of refusing to permit competition where the service furnished by the company already in the field is believed to be adequate and reasonable.

Earnings

A most striking feature of public utility companies is that their earnings do not fluctuate widely between normal years and those of business depression, as is the case with so many other business enterprises. This is due in large measure to the fact that the product of these companies has become a necessity to their consumers which cannot be dispensed with, or even seriously curtailed, when reduction in other expenditures becomes a matter of strict necessity. This fact is graphically illustrated in a chart recently issued by Henry L. Doherty & Company, bankers, in which it is shown that during the past decade the net earnings of gas and electric companies have not dropped below 8 per cent on the securities issued in any year, notwithstanding the fact that outstanding securities covering such properties have been increased during the same period by 110 per cent; whereas in the case of large industrial companies, with their outstanding securities increased only 20 per cent, the average net earnings for the ten years are about 7¾ per cent with violent fluctuations ranging from a minimum of 5 per cent to a maximum of slightly less than 10 per cent; and in the case of steam railroads, with their outstanding capital increased 54 per cent, the net earnings average but 4½ per cent for the ten-year period which has been mentioned.

Reliability of Earning Power

From the evidence submitted it is clear that for reliability of earning power, therefore, the public utility companies stand supreme. This applies as well to the security of the investment, as is shown in the same chart. The comparison of the amount of gas and electric securities in receivers' hands per $100 of outstanding securities, covering a period of thirty years, from 1882 to 1911 inclusive, is 37 cents, compared with $1.93, covering national banks, both insolvent and passing through voluntary liquidation; $1.84 in the case of steam railroads and $2.07 in the case of industrials.

It appears to have been unquestionably established that in respect to permanence of investment and regularity of satisfactory earnings the gas and electric industry stands at the top of the list in the several classes of investment securities.

Regulation

Another feature of these securities which serves as a protection to the investor is the regulation by the public service commissions of the states in which they operate. These now exist in so many states as to be generally regarded as ultimately universal. This regulation covers absolutely the issuance of all new securities and serves as a guarantee to the investor that such securities are regarded as sound and stable by the regularly constituted authorities upon whose sanction they are issued.

As added features of state regulation which are of value to the investor there may be mentioned the standardization of accounts and the enforced publicity as to the earnings and operations of the public-service companies.

Through standardization of accounts investors are assured that charges in general are correctly made and that the various elements of income and expense are so set forth as to permit of fair comparison with other companies. The investor, therefore, has the advantage of publicity of earnings with the assurance that they have been properly established through sound accounting methods and may accordingly be accepted without reservation.

Rate-Making for Central Stations

By William H. Winslow

A VIGOROUS movement is now under way to secure legislative enactments and commission rulings enforcing uniform rates per kilowatt-hour for electric energy sold by central stations. The true reason for the campaign is masked by the statement that the electric-supply companies are selling energy to large users at less than cost and making up their losses by unduly high charges to small users. It is, however, difficult to believe that the people back of the movement are ignorant that the result of their efforts, if successful, would be to deprive the central stations of most of the revenues now derived from large consumers, with the further result that the cost of supplying the remaining customers would be largely increased, instead of diminished.

Uniform Rates

The argument for uniform rates is based largely on that most false and dangerous of statistical deceptions known as "average costs," or the spreading of total costs evenly over total product, the use of which has wrecked many a concern and the discarding of which is an essential feature of modern cost accounting. The only conditions under which a schedule of charges based on a general average cost would not produce disastrous results are those resulting from a complete natural or artificial monopoly. An example of the former is a water-works system having control of the only available supply and thus being able to get from large users a much higher rate than is justified by the cost of supplying them, and also much higher than it would cost such users to pump water for themselves were a supply available. The post office is an example of the artificial monopoly, and its practice of delivering a letter at the same price regardless of whether its destination is across the street or across the continent is a most extreme case of the use of average costs. The only way by which such a practice can be successfully maintained is by making it a penal offense, as it is, to deliver local letters by private agency. Old residents of New York City will recall the "Hussey," "Boyd" and other private letter delivery concerns, which had their own postage stamps and did a thriving business at a fraction of the government rates until they were suppressed.

Low Rates Justifiable

It is plain that central stations have neither a natural nor an artificial monopoly of the supply of electric energy to large users and that if they are to secure such consumers at all it must be by making rates as low as, or lower than, the cost at which they can supply themselves. It is not so clear, particularly to the general public, whose knowledge of cost analysis is naturally very limited, that very much lower rates to large than to small consumers are justified by the lower cost of serving the large consumers. It is the object of what follows to make this point clear.

Take the case of a central station midway between two towns of exactly similar size, to both of which it furnishes electric energy and where both towns use the same number of kilowatt-hours yearly and impose the same maximum demand on the central station, but with the important difference that in one town the central station owns the distribution system, transformers, meters, etc., maintains an office and deals with all the individual consumers, while in the other it sells energy through one transformer and meter placed at the point where its transmission line ends, at the town limits, and has no investment beyond that point and no relations with the individual consumers. In such a case the costs which should be evenly divided between the two towns would be interest, profit, depreciation, maintenance and operating costs on the central station and the transmission lines to the respective towns, while the costs which would be assessable only to the town in which the central station owned the distribution system would in many cases equal 4 or 5 cents per kw-hr., or even more.

Large Versus Small Consumers

Now, in what essential particular does the above case differ from that of a central station having one large consumer, with a maximum demand of, say, 500 kw, supplied at one point, and a large number of small, scattered consumers whose aggregate simultaneous demand is also 500 kw?

If both the single large consumer and the center of distribution for the small consumers were at the same distance from the generating station and the consumption, as well as the maximum demand, were the same, the closest analysis would fail to discover any essential difference between this situation and the one presented by the two towns. When, however, the amount of energy used per kilowatt of demand is greater for the single large consumer than for the many small consumers, and this is very likely to be the case, the difference in cost will be even greater. In a computation recently made by the writer the costs per kilowatt-hour for consumer expenses, transformer and meter losses and fixed charges on lines and poles, transformers, meters and services were figured for a single consumer with a maximum demand of 100 kw and a group of small users with the same demand. It was found that the cost of these items for the small users was twenty-one times as great as for the large consumer, though the assumed conditions were much more favorable to the small users than are usually found in practice.

Cost Analysis

It is, perhaps, not overstating the case to say that in almost every instance a full and correct cost analysis of the business of any large central station would show that the real profits are being made from the large users paying the lowest rates, and that the small consumers are barely paying their way as a class and individually are in many cases being served at a loss. This brings to mind an incident related by an official of a large central station. A large manufacturer came to him and said that there were two things he was unable to understand about the central station's charges: one was how it could afford to sell him the small amount of energy he used at his house at 12 cents per kw-hr., and the other was how it had nerve enough to charge him as much as 4 cents per kw-hr. for the large amount of energy he used at his plant.

This illustrates how the matter appears to a man used to cost analyses in his own business, as contrasted with the way it strikes people who have had no demonstration of the fallacy of the average cost idea.

In most cases rates necessary to secure the business of large users of energy can be successfully defended entirely on the ground of the low cost of serving them, such costs including full return on the investment needed for their supply. It can, however, be shown

that, should it be required to go further than this and make rates yielding less than a full profit, such rates are proper in that the resulting business makes possible lower maximum rates than would otherwise be found feasible.

The real limitation on such rates is contained in the statement that in no event should any rate be made that does not operate to reduce the sum that would otherwise have to be collected from the rest of the consumers.

The Water-Power Situation

By William B. Jackson

AT the present time the abstract question of water-powers is attracting extraordinary attention, and unfortunately much of the consideration of the subject appears to be along illogical and unsound lines. There is a tendency to lose sight completely of the fact that water-powers as property are much like farm lands, which, so long as they are unproductive, add no annual increment to the assets of the community and thereby to the nation, but just as soon as they are made profitably productive they add their yearly quota to the sum total of these assets. Moreover, in the case of every water-power developed and put into service, a definite saving is made in the apparently exhaustible fuel assets of the nation. This is accomplished by making use of power which is otherwise going irretrievably to waste, and it is thus seen that by the development of water-powers a dual advantage is gained. It is also worthy of note that relatively large capital expenditure is necessary in the development of water-powers.

As in the case of land, coal seams and the like, there are some water-powers which are very valuable, there are others which will barely warrant their improvement, and there are still others which under present conditions cannot be profitably developed. As in the case of land and coal seams, it is difficult to predict what the future will bring forth to change the conditions under which water-powers can be profitably developed.

Profitable and Unprofitable Developments

It has become clearly apparent to those who have given the matter of water-powers thoughtful consideration that many of the powers which have been developed in the past have not proved commercially profitable, and from this point of view such powers are therefore not adding to the assets of the nation, but even such developments make a saving in the nation's fuel supply to the extent that fuel would be required to supply the energy generated by them.

The possibility of commercially successful development of water-powers has, of course, been greatly advanced through the improvement of long-distance transmission of electrical energy, but this is only one of the factors which have played important parts in this matter. It is not unreasonable to say that the efficiencies that may be expected from American waterwheels have been improved in general as much as 10 to 15 per cent during the past ten years, and the improvement in generator and transformer efficiencies has also been very marked. With waterwheels giving installed efficiencies of as high as 85 per cent, with generators giving efficiencies of 97 per cent, and with stationary transformers giving efficiencies of 98 per cent, it will be seen that it is now possible to develop water-powers so as to supply to the transmission circuit a very large proportion of the total energy available from the water.

Even in relatively small low-head hydroelectric plants surprisingly efficient use of the water may now be made. In a recent authoritative test of such a plant having a hydraulic head of only 14 ft. the waterwheels showed an efficiency of about 83 per cent and the electric generators an efficiency of over 95 per cent, all losses being included. It should be added, however, that this plant is probably as efficient as any plant of so low a head to be found in this country. But there is some question whether higher efficiency plants of its character cannot be found in Europe, since most European waterwheels are individually designed and constructed for use under the exact conditions to which they are to be subjected, whereas in this country waterwheels of standard construction most nearly fitted for the service required are usually employed. It is probably safe to say that in 1902 no European waterwheel manufacturer made a line of standard waterwheels such as are common in this country. At that time the engineers of the waterwheel department of the Ganz company in Budapest, Hungary, were considering the development of a standard line of waterwheels in accordance with the designs developed by the same manufacturer who built the wheels employed in the water-power previously referred to, and the men in charge of that work for the Ganz company stated that they believed the company was the first European manufacturer to undertake to develop such a line of waterwheels.

Improvements in Waterwheels

The Holyoke waterwheel-testing flume has been in existence for thirty years. It was in existence for a number of years before the great electrical transmission developments became practicable, but so far as can be seen this testing flume has had relatively little effect upon the wonderful improvement in the efficiency and character of American waterwheels which has occurred during the past number of years. The improvement is undoubtedly due very largely to the increasing efficiency of competing prime movers, to the remarkable adaptability and development of the electrical generator and of electrical transmission possibilities, and to the fact that in hydroelectric power developments the amount of power supplied by the waterwheels is known at every moment and the efficiency or inefficiency of the waterwheels is at all times prominently exhibited. It is not difficult for anyone who has been actively engaged in the consideration of hydroelectric developments to recall incidents demonstrating this statement wherein different hydroelectric plants have shown very great diversity in the efficiency with which the waterwheels translate the energy of the water into useful energy, even to the extent of a difference of a third or more, and such conditions in hydroelectric developments are not difficult of detection.

An important and interesting phase of water-power improvement which is little appreciated is found in the fact that there are many powers which considered by themselves are entirely worthless at the present time so far as commercial development is concerned but which may be valuable as a unit in a property having a developed market for electric lighting and motor service and using in co-operation with its water develop-

ments energy generated from fuel. Thus water-power developments may be used in very effective combination with steam generation in such a way as largely to overcome the serious handicap of low-water periods and to mitigate greatly the troubles incident to many low-head developments on account of flood-water periods of steam flow. Under such conditions it is often practicable to improve water-powers which would otherwise be impossible of successful commercial development. For this reason electric-service companies frequently find it possible to make commercially successful developments of water-powers which would otherwise be worthless, and they thereby accomplish a most effective variety of conservation of natural resources.

Considering the present attitude of a large part of our people, it is not surprising that public utility companies established in regions where two or more water-powers are within striking distance of their fields of operation make serious endeavor to control all such powers, whether it is their expectation to develop them immediately or not. It is so easy to make a plausible presentation of the wonderful gains to be derived from a water-power development, even though a thorough and honest consideration of the situation would show it to be totally impracticable for successful commercial development, that it has been possible to improve many unsound hydroelectric projects, with consequent destructive competition in the electric-service fields of established public utility companies and with no net gain to the electric consumers but with certain loss to the principals in the undertaking. This situation has arisen many times during the past few years.

Rates for Service

In the determination of reasonable electric-lighting and motor-service rates for some cities, under commission control, which receive their electric supply from water-powers, commissions have found it necessary to base the rates of charge for service upon the results that might have been obtained from hypothetical steam-driven electric plants planned to supply the electric service for the cities under reasonable steam-generating conditions. This result is attributable to the exorbitant costs of service which arise from the consideration of the established hydroelectric plants serving the communities. We have here a concrete illustration of the uncertainty of the value of water-powers, whether developed or otherwise, which emphasizes the fact that the value of a water-power can be determined only by a full knowledge of the conditions in each particular case. There is a surprising amount of water-power agitation throughout this country, and unquestionably a wrong impression is prevalent regarding the commercial value when considering our developed and undeveloped water-powers taken collectively. There is probably nothing finer than some of our water-powers from whatever viewpoint they may be considered, but it should be emphatically appreciated, especially in connection with low-head powers and in connection with any water-powers where the market for the energy is not already developed or is not in the immediate vicinity, that usually there is great uncertainty as to the commercial value of such powers, and that their value can only be determined by a careful study and examination of all factors entering into the situation. Engineers and all people who have the best interests of this nation at heart ought to assist as far as they can the improvement of water-powers where it is commercially practicable to develop them, since every such development adds in a twofold way to the actual assets of our nation, but in considering this matter they should bear in mind that many of the water-powers now in service have been developed on account of ignorance or dishonesty and are not commercially successful. It may be accepted as almost an axiom that anything which stops or checks the progress of the development of commercially valuable water-powers is a detriment to the country, and unless we decline to accept the well-founded belief that our fuel supplies are becoming gradually exhausted, it is evident that our states and nation may well offer effective inducement for the prompt and efficient development of water-powers under reasonable regulations rather than throw any impediments in the progress of their development.

Public Service Corporations and the Public

By Alten S. Miller

THE increasing rates of interest, coupled with the increasing demands of the public and the decreasing income per unit of service rendered, have created a condition that has made it necessary for many companies to curtail extensions and has also discouraged investments in the interest of economy and good service.

Whether the actions of those controlling the companies are the cause of the unreasoning attitude of the public toward the companies or not, it is axiomatic that the latter cannot be seriously injured without commensurate injury to the public. The time has now come when the people must be made to understand this axiom and to realize fully that their interests are indissolubly bound up with the interests of the public service corporations supplying the transportation, water, electricity, gas, etc., to their communities.

The officers and stockholders of the corporations are of the same clay as other members of the human family, and the public should be made to understand this. For the reason that it is necessary to treat every one alike, general rules must be made which will apply equally to all. Such rules or restrictions are often offensive to thoughtless individuals, but there is seldom any difficulty in satisfying customers as to the necessity and fairness of these rules. Experience shows that when the large majority of the people in a community are reminded that they are dealing with human beings and that they are being fairly treated they will themselves insist that the public utilities be fairly treated.

In a number of places in the country there is a complete understanding between the public utility companies and the people. This is not a result of chance but grew out of the deliberate effort on the part of the companies to educate the people on the subject of their operations, aims and necessities, and to secure public sympathy and co-operation.

It is late, but not too late, to do this same thing everywhere. Few realize how many people in the community are stockholders, officers or employees of the public service corporations or indirectly dependent upon them for their living. It would mean much to have all those so interested working to acquaint the public with the problems of the companies.

Such a general educational movement should be started through the associations representing the prin-

cipal public service activities—railway, gas, electricity, etc. After the details are worked out a concerted movement should be begun all over the United States to enlighten the public and thereby secure its effectual co-operation. It is safe to say that such efforts intelligently directed will, in two or three years, secure for the companies the personal interest of a very large percentage of the people in the communities—a desideratum that every one who has any interest in the subject will understand.

If it is suggested that such a plan is Utopian, the answer is that it has been followed in many places and has produced the desired results. It is neither luck nor graft that sends the head of a large public service corporation to Congress for two terms, with the possibility of many more, or that places other corporation officials in positions of responsibility in the government of states and cities. If each case is investigated, it will be found that the managers and owners have not only been fair to their customers and the public, but have taken the trouble to see that this fact is generally understood.

In conclusion, it is safe to say, in the majority of cases where the companies do not get just treatment, that the fault is by no means entirely on the side of the public. Though the companies may have been more than fair in the treatment of their customers, their duty does not end here. The public must be informed of all the facts, and thereby convinced that the company is fair.

Hydroelectric Transmission Systems

By Louis Bell

THE past year has been somewhat notable for the upward tendency of voltage in transmission work. The little group of plants operated at 100,000 volts and upward is growing more considerable, as reference to the various projects described in the columns of the *Electrical World* during the year will amply show. The interesting part of the situation is not so much that one plant or another has gone on to the higher range of voltage, but that it has done so without any particular difficulty. The early steps in long-distance transmission were handicapped by fear of the machines. Twenty years ago high voltage either in the generators or transformers meant, at the most, a few thousand. The intelligent use of oil and artificial cooling very rapidly removed the limitations that lay in the apparatus itself, and the difficulties were transferred to the line. After it became possible to place trust in the transformers the voltage shot upward to the vicinity of 40,000 within a very few years. Then came a halt due to improper insulator design more than anything else, as well as the beginning of the coronal effects which introduced new difficulties of unknown magnitude. It took a considerable amount of experience and many improvements to render line insulation reasonably safe at 60,000 volts and to demonstrate the limitations of difficulty from the coronal discharge. Then for some years the voltage of first-class conservative practice held steady, and the final impetus which has resulted in the fine group of plants at 100,000 volts or more was due purely to the suspension insulation, which got rid at once of many difficulties.

Commercial Considerations Paramount

The next forward step will be determined by commercial rather than by engineering considerations, for it must be very clear that the way is now open for any voltage likely to be desirable in the near future from the economic standpoint. In other words, present conditions enable one to take care of any distance now commercially desirable on the face of the facts regarding costs of coal and copper. The 240-mile transmission project just started at 135,000 volts in southern California is the longest straight-away transmission yet undertaken, although similar distances have practically been reached around a network. The other top voltages in actual use range around 110,000, with 120,000 and even up to 150,000 looked for in the near future. The extreme voltages proposed belong to the transmission plants on the Pacific Coast, but it is worth noting that, in addition to the three or four Southern plants in the Appalachian region using 100,000 to 110,000 volts, some recent lines of the Connecticut River Transmission Company are being built for 120,000 volts. Even in the New England climate the suspension insulator has turned the trick so far as high voltage is concerned.

Corona Effects

The once feared difficulties with coronal discharge have proved of little practical moment, not because the discharge has been avoided or is a thing which can safely be neglected, but because of the long transmission systems which demand extreme voltage are by conditions of economy confined to projects in which large amounts of energy are involved and the size of the line wires is such as greatly to reduce the coronal effect. In other words, transmission systems big enough and long enough to demand pressures at which there is serious danger from coronal discharge automatically supply a remedy because of the size of the conductors required.

Notable Hydroelectric Installations

Aside from the questions of voltage, the past year has furnished some notable constructions and some details of very exceptional interest. It has been marked, for instance, by the completion of the first half of the great Keokuk project of 150,000 hp in the wheels, transmitting energy at 110,000 volts as far as St. Louis, nearly 150 miles. This plant, being at a very moderate head, involved unusual hydraulic features, including high-power vertical shaft wheels at the very low rotative speed of 57.7 r.p.m. They are by far the biggest low-speed wheels in use in any existent hydroelectric station. The anthithesis of this plant in head and equipment is to be found in the wonderful Big Creek development, an account of which is printed elsewhere in this issue.

Another conspicuous item of the year in hydraulics was the sensational performance of the 6000-hp turbines for the Appalachian Power Company. These wheels under test reached the highest point of full-load efficiency that has yet been recorded, 93.7 per cent, and at moderate loads still showed efficiencies well above those heretofore recorded for wheels under similar conditions. This remarkable performance resulted in an efficiency of 88 per cent from water to busbars, again a record figure well maintained at more moderate loads. The point of the matter seems to be that with wheels working under sufficient head to give a fairly normal design remarkable efficiencies can be obtained provided the output is sufficiently great. Wheels oper-

ating under freak conditions of speed or head cannot be expected to do so well, yet it is very evident that wheel design on the whole has been so far improved within the past few years as to reduce greatly all the losses save those which must be classified as physically unavoidable.

Another plant worthy of special notice on account of the hydraulic situation is that at Hale's Bar, on the Tennessee River. Here the fundamental difficulty is variable head, the *bête noire* of the hydraulic engineer, and in this case the variation between low water and flood is from 40 ft. to as low as 19 ft. This very uncomfortable situation was met by placing three turbines on each vertical generator shaft, two of them being used together at times of fairly high head and moderate flow, and the third added only when the head is reduced by flood conditions. This is, of course, an extreme of variable head, but no better solution of the difficulty has been devised than this of multiple wheels. When the head is sufficiently high placing them separately on the shaft, as at Hale's Bar, is the natural arrangement. The arrangement tried on one of the well-known Swiss plants, a composite runner with three sets of buckets arranged radially to meet the difficulty of extreme low head, has not yet been used in America. Nor has the scheme, tried years ago in one of the plants on the Willamette, of an additional turbine coupled to a separate shaft for low-head work connected to the dynamo shaft by pulleys and a wide belt been repeated elsewhere.

Tendency Toward Simplification

A phase of the transmission work noticeably shown in the current year has been a very laudable tendency toward simplification in some of the details. The outdoor substations of the Tallulah Falls plant and some others in the same region are certainly steps in the right direction, as also are the open-air switching stations used, for example, by the Central Georgia Transmission Company. They are signs of relief from the enormously bulky and costly switch gear which have been in use. A still further step in the same direction is that taken by the Southern Sierras Power Company in the plant already alluded to, in which there is a large bank of pneumatically operated open-air switches of the horn type with double break whereby the machines are synchronized on the high-tension side, to the considerable simplification of the station. Such successful revolt against the great cost and complication of the switchboard work in some of the larger transmission stations is encouraging.

Line Construction

In line construction there has been nothing of great novelty. In most of the large installations use is made of the ordinary tower system, although there has been an increase in the use of A-frames. However, line practice in the Drum transmission of the Pacific Gas & Electric Company is worth commendatory notice. Here part of the 110-mile line is subject to very severe weather conditions, and on this portion an extremely strong construction with stranded copper conductors is employed, while for the sake of economy the rest of the line, where the exposure is more favorable, is of aluminum. Incidentally, it may be noted that this particular system has transformer taps arranged so it can be operated from 110,000 volts up to 125,000 volts as may prove desirable.

In closing these notes on high-voltage transmission special mention ought to be made of the decision reported of the State Corporation Commission of Virginia in relation to high voltage and public safety. A complaint was raised by property owners against the construction of a 110,000-volt line in the main along a railway right-of-way. The arguments displayed the same unreasoning terror which used to rouse protest at 10,000 volts, 20,000 volts and all the way up. The decision backing up the project in the most unqualified manner and intimating plainly that the petitioners were victims of needless, though perhaps excusable, fear will go far toward discouraging future attempts to block high-tension construction by legal action.

Developments in Prime Movers

By W. F. Durand

PROGRESS during the past year in connection with central-station prime movers has been detailed and plodding rather than spectacular and epoch-making. It has concerned itself primarily with attempts at a more perfect solution of the general power-plant problem; with search for a more perfect adjustment of the balance between the economic, commercial and engineering factors which supply the regulating conditions under which electrical energy as an article of commerce must be generated and sold.

In the matter of fuels, coal and oil retain substantially the same relation as in recent years. The choice between the two has become an economic rather than an engineering question, and the chief factors which enter into the problem are therefore the relative costs of production and the relative rates of production and demand as between the two fuels, with any other matters which may exercise a determining influence on the relative market price of the two. The most significant tendency of the times in this connection is the growing use of oil as a marine fuel and the recent large extension of its use in our own navy, coupled with the suggestion from the Secretary of the Navy that the government should lose no time in acquiring and reserving oil fields promising an adequate supply for the demands of the naval service.

Boiler Room Practice

Improvements in details in connection with boiler-room practice are steadily appearing. In the combustion of oil fuel, mechanical atomizers are continuing to attract some attenion among engineers generally. In the marine field they represent the standard equipment, providing as they do for atomization without the loss of fresh water by way of the furnace gases. Up to this time, however, the actual atomization is not as perfectly performed by such means as by the use of steam. In consequence, while the atomization, as a step in the program of oil fuel combustion, is performed more cheaply than by steam or compressed air, the resultant furnace economy is somewhat lower, as a rule, leaving the resultant combined economy only slightly if any in favor of the mechanical atomization. There is often, furthermore, a somewhat greater limitation in the range of capacity with good economy than with steam atomization. What is wanted is some form of mechanical atomizer which will realize the atomization of the fuel with the economy in energy expenditure of the best of

such devices, and with the effectiveness and resultant furnace efficiency of the best of steam atomizing burners. With such a burner the over-all boiler economy will profit by some 2 to 2.5 per cent, the difference between the 3 or 3.5 per cent of the steam now used by steam atomizing burners and the 1 per cent or less, in terms of equivalent energy, used by mechanical devices.

Indicating and Analyzing Devices

The experience of the year has justified the growing interest in and dependence upon measuring, indicating and analyzing devices for the intelligent control of the conditions of boiler operation. Flue-gas analyzers and recorders, draft indicators, so-called economy meters, etc., are all taking their part in reducing the margin of loss by way of the fire room. It may be well to remember, however, that the best economy device in a fire room is a good fireman—a man who will use these various aids intelligently and as guides to his program of fuel, feed, air and draft control. No instrument or combination of instruments can take the place of brains in the fire room. On the other hand, it is equally true that no amount of brains will serve to determine unaided the conditions of operation with the readiness and certainty secured by the aid of the various instrumental indications and helps. The fundamental conditions of fire-room economy are simply these—complete combustion of the fuel with the minimum excess air and the maximum transfer of the liberated heat through the heating surface to the water, and the consequent rejection of the stack gases with minimum weight and temperature; but the best combination of trained intelligence with instrumental helps and guides is none too good to determine moment by moment the dispositions suited to realize the best result out of these seemingly simple controlling conditions.

In order more perfectly to realize some of the desirable conditions of operation, there has been a growing tendency in recent years to make the operation of certain factors as nearly automatic as possible; that is, to make them as nearly as possible directly dependent on the boiler conditions without dependence on human intervention. Thus systems of automatic draft and damper control, automatic control of feed water and automatic control of fuel supply, either liquid or solid, are all receiving consideration on the part of progressive engineers.

Status of Steam Turbine

In the matter of generator prime movers themselves, the situation of the past few years is substantially unchanged. The steam turbine remains alone and unchallenged in its acceptance as the typical large-unit central-station prime mover. On the other hand, little progress has been made in extending the application of the turbine downward to small sizes, at least with such improvement in efficiency as will enable it to compete in this part of the field with the reciprocating steam engine, still less with the internal-combustion engine. The small turbine with its direct production of high-speed rotary motion has thereby certain direct advantages for the operation of various auxiliaries such as turbine pumps and blowers; but for the main power unit in small sizes the relatively poor economy of the turbine in such sizes rules it out of present consideration, at least where thermal economy is an item of primary importance. The situation thus presents, in the field of the small unit, two prime movers available and bidding for recognition, the reciprocating steam engine and the internal-combustion engine, and in the field of the large unit the steam turbine alone, with a debatable middle ground within which one form or another may be chosen according to special circumstances.

Competition Between Reciprocating and Internal-Combustion Engines

The present competition between the improved forms of reciprocating steam engine and the internal-combustion engine for recognition in the small-unit field is most interesting and significant of the times. The inroads of the latter into the field long held supreme by the former have brought about still further improvements until at the present time the reciprocating steam engine stands as one of the most highly refined and perfected products of engineering skill. Its inherent limitations, however, still leave it inferior to the internal-combustion engine in point of thermal economy, and the engineer is thus confronted with two forms of prime mover, for one of which (the internal-combustion form) may be claimed the best thermal economy yet attained. But with it there must be admitted certain limitations in character of fuel and a likelihood of somewhat greater repair and maintenance bills, while for the other (the reciprocating steam engine) there may be claimed a high degree of mechanical adaptation to the demands of the situation, relative simplicity and low cost of upkeep, though there exists also some relative disadvantage in thermal efficiency.

In accord with the spirit of the times, the consideration relating to thermal economy receives increasing and even ruling weight, and as mechanical improvements and greater familiarity on the part of operating engineers are tending to reduce the relative disadvantages on the score of reliability and cost of upkeep, there is to be noted a definite advance in the status and use of the internal-combustion form. It is perhaps too early to predict the entire disappearance of the reciprocating engine from this field, but at the present time the extent of its use is subject to a marked and continuous relative shrinkage.

Steam Turbine Improvements

Regarding the steam turbine as the typical power-station prime mover, advance in three directions during the year may be noted—namely, improvements in economy, advances in size and wider adaptation to varying conditions of use.

As to economy, note should be made of the construction due to Dr. Ferranti for the use of highly superheated steam gas with superheating between stages. This turbine was referred to in an address by Dr. Ferranti nearly a year ago on the occasion of a James Watt anniversary lecture at Greenock, and it was stated that the tests made indicated a full-load consumption of 0.55 lb. of oil fuel for one shaft horse-power hour, or a thermal efficiency of 24 per cent and better. These results indicate the immediate thermal possibilities with a highly superheated steam gas. There remains the serious difficulties of a mechanical nature to be overcome in connection with the utilization of such a high-temperature medium, difficulties which are said to be satisfactorily met by Dr. Ferranti's construction. This result places the turbine economically not far removed from the Diesel engine and represents the present extreme advance in the use of highly superheated steam.

There remains also the inviting possibility of mixed-vapor turbines. The mixed-vapor-heat prime mover is old in idea and is simply a device for widening out the thermodynamic range of temperature covered by the working cycle. Thus steam and ether or a like substance might be used to extend the range below that realized by steam alone, assuming that a condensing medium at a suitably low temperature were readily available; or, on the other hand, the vapor of some liquid-like mercury might be used with steam to extend the temperature range above that ordinarily available with steam. If such a construction should be at-

tempted, it would be of interest to learn how the economy to be gained would compare with that given by the direct use of steam gas superheated to the mercury-vapor temperature as in the Ferranti turbine above noted.

In the matter of size there seems to be no present limit. The maximum rating has rapidly risen past the 10,000-kw and 20,000-kw sizes and is now at the 35,000-kw point, with loud whispers already of a 50,000-kw unit. These enormous units mean economy thermally and economy in space occupied per unit of power developed. Obviously, however, they are only applicable in stations of large size where they can find an effective place on the daily load curve.

In the matter of adaptation to varying conditions of use, the mixed-pressure turbine is attracting increased attention. This turbine is intended to operate either singly on high-pressure steam or in combination with reciprocating engines on exhaust steam. The combination of low-pressure or exhaust-steam turbines with reciprocating engines has exercised an important influence on over-all station economy in the case of many stations originally equipped with engines. The use of a turbine in this manner has not, however, always provided a combination with sufficient flexibility to meet all conditions of station demand, and the mixed-pressure turbine has been developed to meet more effectively these varying station demands. Such a turbine may receive steam directly from the boiler, or from the engine exhaust, or from pump exhausts or other auxiliary equipment, and it will thus serve to open out the thermodynamic range of all steam so employed to the lower limit reached by the turbine itself.

Internal-Combustion Engines

Recurring briefly to the internal-combustion engine, the Diesel or heavy-oil type is attracting wider and more favorable attention as the difficulties of mechanical construction are being more effectively met and the conditions for effective use more clearly understood. In the marine field sizes have been carried up far beyond those proposed or used in stationary practice, and with perhaps questionable policy. At least for central-station service, the present limitations of such engines to sizes of 1000 kw to perhaps 2000 kw as a maximum should be accepted until the peculiar difficulties connected with the large size of cylinder are more effectively overcome.

It may be noted as an interesting fact that with the turbine form of construction large units make for simplicity of construction, economy of operation and general availability, while in small sizes the construction becomes more difficult in certain ways and the efficiency is lower in marked degree. On the other hand, with the internal-combustion engine the small size is easily built and is efficient in operation, while serious troubles, chiefly in connection with cooling, are introduced by extension to very large units.

The specific consumption of the heavy-oil engine has now become established at not far from 0.4 lb. oil fuel per hp-hr. under full load and favorable conditions. This fact alone will work powerfully for its continuing introduction and for wider extension of use, as further study may serve to remove difficulties and limitations of a mechanical or operative character.

Gas Turbine

The gas turbine is still attracting some attention from engineers and inventors, and reports have appeared of an apparently successful design and construction by Holzwarth, of Mannheim, Germany. This turbine is rated at 1000 hp and is said to have given very hopeful indications of successful operation with a high thermal efficiency. The gas turbine will have the advantage of direct rotary motion as compared with the reciprocating motion of the ordinary internal-combustion prime mover. It remains to be shown, however, whether it will be able to demonstrate any decided improvement in economy, and also whether there will be the same limitation in the matter of size and output of unit as in the case of the reciprocating internal-combustion engine.

Improvements in Lamps and Lighting

By Preston S. Millar

IN a brief review of developments in electric lighting during 1913 improvements in electric illuminants stand out as a prominent feature. In this respect notable advances have been made. In other respects, while the development has been normal and gratifying, there have been no radical improvements.

Incandescent Lamps

For the first time the number of tungsten-filament lamps sold in this country exceeded the number of plain carbon and graphitized lamps. The tungsten lamp has now been applied to practically all classes of service with satisfactory results. It has been improved in many respects, though the improvements have been inconspicuous and little heeded by users of the lamps. During the year the use of a bulb-blackening preventive has been extended to the middle and smaller sizes of lamps, thereby improving their candle-power maintenance. With this has gone improvement in the ruggedness of the filament and improvement in the manner of supporting the filament which further contributed to ruggedness. Tungsten lamp efficiencies have been increased over those of 1912 by from 5 to 15 per cent without decrease in life of the lamps.

The year witnessed the announcement of the development of the tungsten gas-filled lamp and the beginning of manufacture of such lamps upon a commercial scale. As large-diameter filament and high current values are prerequisites of efficiency in this type of lamp, its application appears, for the present at least, to be limited to lamps of the series type and to large lamps of the multiple type. The early efforts of the manufacturers during the past year are understood to have been directed toward the development of 750-watt and 1000-watt multiple lamps and 20-amp auto-transformer lamps for use on existing alternating-current series circuits, as well as lamps of 60-cp and above for use upon series circuits of 6.6 amp and other standard current values. The specific consumption up to date has ranged from about 0.75 watt per mean horizontal candle-power for the smaller lamps to 0.5 watt per mean horizontal candle-power for the larger lamps.

Little has been accomplished during the year in the way of answering the many practical questions which the development of this lamp has raised. It cannot be said that it has been determined in just what form the gas-filled lamp will find its largest development. It is clear, however, that it joins with the arc lamp in creat-

ing a demand for operation at higher current values in order to realize the best obtainable efficiencies, and that its influence, like that of the newer developments in arc lamps, will be to foster the use of high-power illuminants particularly in the lighting of streets and other large areas.

Arc Lamps

The most marked developments in the arc-lamp field during the year have been the further improvement of the inclosed or long-burning flame-arc lamp and the extension of the use of the ornamental 6.6-amp magnetite lamp. In the development of the flame-arc lamp the manufacturers of electrodes have made advances. The manufacturers of the lamps have found much with which to occupy themselves in overcoming many of the details of design, construction and operation with which they have had to contend in inclosing the flame arc. The demand for white-light electrodes appears to have increased, the superior color more than compensating for the reduction in efficiency amounting to from 15 to 20 per cent. The manufacturers of both types of arc lamps have turned their attention toward operation at higher current values in order to secure the added efficiencies of which the arc lamp must avail itself if it is to hold its own against the competition of the tungsten gas-filled lamp.

Vapor-Tube Lamps

No radical improvements have been reported in vapor-tube lamps, though the neon lamp has been drawn to the attention of American engineers rather more prominently on account of its demonstration in this country during the year by the inventor, Mr. Claude.

Central-Station Practice

A notable change in lighting practice of central stations during the year has been the extension of the free renewal practice by the larger central stations to include the largest size of tungsten lamp. It would appear that the managements of most large central stations subscribe to the policy of controlling the supply of lamps, even though tungsten lamps may not be given free of charge. Some central stations, however, have abandoned the handling of lamps entirely, turning the lamp business over to jobbers and contractors in their territory. In some few cities where rates have been reduced through city regulation actuated by political rather than economic considerations the central-station companies have been compelled to avail themselves of the opportunity which the introduction of the tungsten lamp affords and have abandoned the free renewal practice, thereby reducing their costs by, say, 0.5 per cent kw-hr., and in part compensating themselves for the reductions in rate which have been forced upon them by unreasoning regulation.

In spite of the fact that the sale of energy for motor service is becoming an ever-increasing proportion of the total business of central-station companies, there was manifested during the year a tendency on the part of such companies to devote more attention to furnishing a good lighting service. There seems to be a realization that, though the lighting part of the business may not bring the largest income, it is, on the other hand, the part of the business in which the company comes into contact with the larger number of customers, and it is, therefore, the part of the business in which there is the greater opportunity for cultivating good public opinion in regard to the service rendered. This added attention to the lighting service manifests itself in a number of ways, including the employment of lighting salesmen or illuminating engineers.

Street Lighting

During the year there have been few, if any, new installations which have set higher standards than before either in intensity or other features of street illumination. There is a tendency toward increasing intensities through the use of larger and more frequently spaced illuminants which is coming about as a matter of growing appreciation of the importance of street lighting. The more liberal use by municipalities of light in streets has been promoted by the many merchants' street-lighting installations of display character. These indicate the advantages of better lighting and the disadvantage of inadequate lighting in other parts of the same cities.

A noticeable replacement of gas-mantle lamps by tungsten-filament lamps has marked the year's record.

Illuminating Engineering

Tendencies in illuminating engineering have indicated broader conceptions of the opportunities and responsibilities resting upon the lighting practitioner. Illuminating engineering is coming to be recognized as artistic engineering of light. This has entailed a realization of the unique character of this specialty, and few engineers who have examined the subject now fail to see in this a distinct specialty.

In illuminating practice the general use of more decorative and artistic lighting auxiliaries and the more general insistence upon lower orders of brightness for light sources have perhaps been the chief developments of the year.

Society Activity

The Illuminating Engineering Society has quietly developed its activities, broadening its scope and securing a larger measure of support from the lighting industry. At the close of the year its promise of future usefulness appears brighter than ever before.

The International Photometric Commission was reorganized during the year to form the International Commission on Illumination. American participation in this international body is through the United States national committee, which is supported by those of the national technical societies which are more immediately interested in matters of illumination. The first meeting of the commission, held in Berlin during August, was attended by a delegation from the United States national committee, the members of which took prominent part in the organization of the new body. This commission appears likely to serve in the illumination field a purpose similar to that served by the International Electrotechnical Commission in the electrical field.

Photometry

There have been no notable developments in photometry during the past year. The wide range of color now encountered in ordinary commercial illuminants imposes a requirement for the perfection of methods of heterochromatic photometry, and this requirement is further emphasized by the growing tendency to resort to photometry in a broad range of lighting practice in fields in which previously it has not been employed. It is understood that in a number of laboratories independent investigations are under way with a view to developing improved methods of heterochromatic photometry, and it would appear that some means for coordinating these efforts is desirable. This is a problem of such difficulty that the efforts of all laboratories in the country might well be combined in securing the best solution of the problem. The standardization of a wide range of color screens for the simplification of commercial photometry is a step which has become generally desirable during the past year.

In general, photometry may be said to be less important as a generally employed routine process, as in the rating of incandescent lamps, and to be of growing importance in a wide range of work in which it is used as an aid in the design of illuminating installations and in the study of the qualities of illuminants. In the former the measurement of brightness of illuminated objects has become recognized as an essential supplement to the measurement of illumination intensities.

In General

The developments of the past year may be said to have been in most respects wholesome in character, making for improved illumination. A survey of the lighting conditions in this country indicates as the most important requirement to better illumination extensive educational work in order to convince the public of the importance of good illumination. A number of agencies are at work and have accomplished much during the past year in this direction. Their achievements, however, have only served to demonstrate the need for much greater effort along this line. Lighting practice lags greatly behind knowledge of lighting principles. General practice should be brought measurably close to best practice in illumination. The experience of the past year has indicated that this can be accomplished only through arousing public sentiment in favor of good illumination.

Radio-Telegraphy and Telephony

By John L. Hogan, Jr.

THE year just closed has seen marked progress in the unification of radio-telegraphic practice by a tendency toward the use of better methods of transmission and the partial abandonment of obsolete instruments. While by far the greatest number of messages and existing stations are involved simply in the ship-and-shore traffic, there are being installed and developed in competition with wire and cable telegraphs "wireless" spans over great stretches of land and sea. Radio service continues and seems ever to extend its humanitarian work in the protection and saving of lives at sea; and in 1913 the effectual enforcement of legislation requiring that each station constantly maintain an operator on duty has resulted in rescues of several ships whose fate would otherwise have been, at the best, uncertain. In this work, however, all is not yet what it might be, since except in a few notable instances the emergency equipment installed aboard most vessels, and upon which absolute dependence must be placed when accident disables the ship's power supply, is of the ancient and ineffective induction-coil type. The federal radio inspection service of the Department of Commerce has done much toward securing and upholding a moderately high standard of utility among shipboard installations, but cannot immediately insist upon too rigid application of all good service criteria. By law, every ship transmitter, whether the regular or the emergency outfit, is required to be capable of signaling 100 miles under average daylight conditions, but it is a matter of common knowledge that the letter of this ruling is often reached only by most adroitly taking advantage of the favorable times for demonstration transmission. When there is reached a still better co-operation between shipowners, the radio companies and the Department of Commerce it is probable that the spirit underlying the legislation will be met, to the vast benefit of service and the further safeguarding of those at sea. If, at the same time, the restraint and punishment of vicious experimenters and the encouragement of legitimate and useful activities on the part of amateur operators can be increased, it seems likely that there will be caused no more suffering such as that which, only a few weeks past, was brought about by the criminal and unfounded report of accident to the S. S. *Rio Gande*, sent broadcast by some unknown radio degenerate.

Space Signaling

In addition to the normal ship-and-shore communication and to competitive radio-telegraphy which now bridges both the Atlantic and the Pacific, a number of special applications of space signaling have been undertaken. The governments of France and the United States have been experimenting between Paris and Washington, direct by wireless, in securing exact data for comparing the velocity of grounded electromagnetic waves to that of light, and several railroads are attempting to establish reliable communication with moving trains and to adapt the radio service for emergency train dispatching in event of serious wire trouble. The military uses of the art have undergone development, with especial emphasis upon signaling from aeroplanes when under way and on the design of simple and portable apparatus for field telegraphy. In some cases plants primarily intended for a single use are actually utilized in other ways; for example, immediate construction of the long-discussed British imperial chain of stations has been urged on the ground that they are expected to be of the greatest utility in connecting England's scattered possessions when cables may be cut, yet the normal and peaceful occupation of the tremendous installations is to be the transmission of private toll telegraph correspondence.

The courts, in both their criminal and equity branches, have contributed toward the progress of radio transmission. Some ten or twelve patents are the basis of infringement suits which have been prepared for or have reached final hearings during the year, and two patents have been sustained in the Appellate Division of the Federal Circuit Court. The adjudication of these, together with decisions which are looked for in the near future, will do much toward settling the painfully involved patent tangle which has so long vexed radio engineers of the United States. In litigation of another sort the activity of the post office authorities has brought to book a third group of men who were alleged to have used radio-telephony and telegraphy as a basis for fraudulent stock manipulations.

Progress in Design

In the engineering work of radio transmission essential data are being determined continually, although new problems seem to present themselves for solution as fast as the older ones are put aside. Completion of the navy's high-power station at Arlington, Va., near Washington, has given opportunity for investigation of the relative values of sustained-wave and grouped-wave-train transmitters under some sets of conditions, and information on this as well as on the comparative values of several classes of receivers has been gained by a long series of trials. New speculations have been

advanced as to absorption and other phenomena which appear to accompany transmission of earthed waves over great distances, and not only have various theories been proposed but several organizations are taking steps toward almost world-wide simultaneous observations of signals and disturbances in such ways that the resulting data should be of vast assistance in arriving at and demonstrating accurate transmission theories. Design in general shows a trend toward standard practice, since various types of apparatus have been in use sufficiently long to show their respective advantages and faults, and, unless further patent complications arise, it seems likely that the products of all manufacturers will become much alike in general principles at least. Standardization through the year has not been confined to a process of evolution in the instruments themselves, since the loose usage of the art's nomenclature has been attacked by the Institute of Radio Engineers, with the result that a "Standard Report" of preferred symbols, terms and definitions is soon to be issued.

Wireless Patents

The year 1913 has been quiet in so far as issue of wireless patents is concerned. Important disclosures as to generators of sustained radio-frequency alternating currents, amplifiers and general receiving methods have been made; but there has been a satisfactory lack of the detail patents, having little or no value, which were so common only a few years ago. Enough inventions have been announced to show a definite trend in the international development of radio-telegraph apparatus, and this is toward signaling with sustained waves wherever possible. The tendency toward the use of continuous forced radiation in conjunction with receivers acting to produce musical "beat" tones by interference between two inaudible frequencies of current is shown, especially in design of plants intended for communications over great distances, where economy in antenna and other investment becomes markedly important. In smaller stations, for shipboard use or for transmission of only a few hundred miles, waves occurring in regular groups of comparatively high frequency and so producing a musical tone at the receiver are becoming nearly universal practice where the ability to signal continuously in spite of atmospheric disturbances is required. Where minimum first cost is of the greatest importance and the best class of service is not required, it is customary to rely upon the older types of slow-spark apparatus for distances of 100 miles or 200 miles.

Transatlantic Radio-Telephony

Transatlantic radio-telephony has again come forward in widespread announcements through the press, but investigation of the two claims made has shown one of them to have been based upon an erroneous translation of "telegraph" and the other to refer to the transmission of a simple musical tone such as might be used in telegraphy. This is not much nearer to actual speech transmission than were the promises which linked Denmark, France and the United States in 1906 and 1907. In its serious development, however, radio-telephony has gained impetus during the past year through the work of European investigators on methods of generating practically continuous waves and modulating them in accordance with vibrations of the voice. Well-authenticated records of transmissions over several hundred miles are available. The practice of this art seems likely to develop in two directions, one pointing toward distortionless speech transmission over greater distances than can be reached commercially by wire or cable, and the other toward short-distance signaling between radio stations which need communicate only occasionally and at which, therefore, a Morse operator involves a prohibitive expense. For long-distance trunk "line" work by radio it is necessary to develop uniformly operating means for modulating the large amounts of radio-frequency power now available from single machines. For small-set service there must be produced an inexpansive, simple and reliable generator of waves suitable for space telephony. At the present time work is being directed along both these lines, so that it is not too much to hope that commercial radio-telephony will become an accomplished fact within the next few years.

Storage-Battery Industry

By Lamar Lyndon

THERE have been no radical changes in storage-battery design or construction during the past year, either in the lead-sulphuric acid or in the nickel-iron-alkaline types.

There has been the usual large demand for the smaller stationary cells for miscellaneous purposes, but very few installations have been made of the larger Planté cells such as were used in the past for the regulation of fluctuating electric loads.

Large Battery Installations

A number of large "stand-by" batteries have been installed on three-wire direct-current distribution systems for insurance of continuous service, and these have practically all been of the pasted-plate type. The use of batteries in this way is becoming increasingly desirable for the important lighting loads of the business, theater and hotel sections of the larger cities, where absolute dependence is now placed on electric lighting. The larger central stations have obtained almost perfect service records through their use. Improvements in such installations have been principally in auxiliary apparatus, and particularly in the large end-cell switches that are employed for voltage regulation.

The steam railroads are continually increasing the number of electrically lighted coaches to meet the demand of the public for this convenience. The various manufacturers are furnishing smaller and less expensive axle-driven generating equipments for this purpose, and improvements in such apparatus have made it possible to use smaller batteries.

The United States Navy has added a number of submarine torpedo boats to its fleet during the past year, and both their size and power show a decided increase. Very large storage batteries are employed for running these boats submerged.

Portable Batteries

The general adoption of electric starting devices for gasoline motor cars has created an enormous demand for the portable batteries used with these equipments. No exact figures are available, but it is probable that there have been furnished more than 500,000 cells for

this single field. Even the small, cheaper cars are generally to be provided with electric self-starters in 1914, and the coming year will require a greatly increased output of these batteries.

Many central-station companies have been devoting a great deal of effort to promoting the use of both the pleasure and the commercial electric vehicle, and in many cases they have obtained very gratifying results. The greater cost of the electric vehicle has been a handicap to its wider use, but several manufacturers promise a considerable reduction in the prices, which they propose to obtain by standardizing and producing on a large scale. Such a reduction in price will no doubt greatly accelerate the introduction of these types of vehicles.

Several manufacturers are actively pushing the sale of baggage and freight-handling trucks, and such apparatus promises to have a wide use. The freight and passenger terminals of the larger railroad and steamship lines are rapidly installing these trucks. An increased number of storage-battery locomotives have been placed in service in mining, tunnel and industrial plant work.

The storage-battery street cars in operation in New York City continue to show a gratifying performance, and at last the displacement of the horse-cars on the remaining cross-town lines is definitely in sight.

The sale of the small, inexpensive farm-lighting outfits, comprising a gas engine, generator, switchboard and battery, has been extensive.

A number of Edison batteries in the present form have successfully passed a four-year period of service. Their rugged mechanical construction is a factor in their favor for such vehicles as are subjected to heavy shock. Their heavy first cost, which is about three times that of the lead battery, and the excessive current required for their charge, are handicaps under which they labor.

Electrochemistry in 1913

By E. F. Roeber

THE deep and far-reaching effects of electrochemical research on engineering fields, of which few will think in connection with electrochemistry, have recently been emphasized by the invention of the nitrogen-filled tungsten lamp. And yet this is only the last in a long series of contributions of electrochemistry to illuminating engineering, which includes the incandescent gas mantle, the impregnated-carbon electrodes of the flaming arc, and the invention of the whole range of metallic-filament lamps from osmium to tungsten, the increasingly high temperatures necessitating the use of the electric furnace for the research. If we couple this observation with the fact that this same electric-furnace research with pure rare metals has had an immense effect on alloy steels and their various applications, we have an illustration of the ways in which electrochemical advance in a single field is interlinked with the progress of modern civilization in widely differing directions.

In the field of electrochemical industries proper—those using electric furnaces or electrolytic processes on a large scale—the past year has been characterized, not by salient revolutionary developments, but by a steady conservative and healthy growth, and it is probably for this reason among others that the new tariff act, in spite of the many and considerable cuts in the tariff for electrochemical products, does not appear to have seriously affected the inherent strength of, say, the Niagara Falls electrochemical industries. Truly, they are, in the overwhelming majority, no longer "infant industries."

Developments in Fertilizer Industry

Without entering into any details of these many very different industries, some remarks may be made on two problems of broad, surpassing, timely interest. One relates to developments in the fertilizer industry, the other to the application of electrochemical methods in metallurgy. In the fertilizer industry we have a problem with many ramifications, which seems to become still more complicated by the projected and partly accomplished application of the Ostwald process in connection with calcium cyanamide manufacture.

In several European calcium cyanamide factories the cyanamide is converted by treatment with steam into ammonia for the production of ammonium sulphate. With the Ostwald process, on the other hand, it is projected to work up the ammonia (produced from the cyanamide) into nitric acid and nitrates. If successful on a large scale, this method will bring the cyanamide manufacture into competition with the Norwegian interests making nitrates and nitric acid from nitrogen oxide produced by the Birkeland-Eyde process of electric discharges through air. This latter industry is now essentially Norwegian, as the Badische company has withdrawn from Norway to take up in Germany the production of ammonia for nitrogen and hydrogen by Haber's synthetic process. The much-discussed Serpek process is still in the embryonic state; if it succeeds on a large scale, it will be another source of ammonia, but would be far more important as a producer of cheap alumina and would have a decisive effect on the aluminum industry. This is another example of the peculiar way in which subjects apparently very remote from each other are linked together by chemistry.

The Electric Furnace in the Iron and Steel Industry

In the application of electrochemical methods to metallurgy, the use of the electric furnace in the iron and steel industry remains in the foreground of interest. The production of pig iron from iron ore in the electric reduction furnace is still restricted, and will be for some time to come, to Scandinavia and California; while, starting with furnace designs of surprising similarity, though independently developed, further progress has tended to increase more and more the differences in design of apparatus as well as in the method of operation to suit the local requirements of the two localities. The California product is a soft gray foundry iron.

In the steel industry the electric furnace has three applications. First, the production of high-grade steels, in competition with crucible steel; in this respect the electric furnace makes steady, sound progress. Second, the electric refining of Bessemer converter or open-hearth steel for the production of large-quantity products, like rails of higher quality; in this respect the progress is disappointingly slow, but it is possible that years of experience with the electric steel rails now in use will be required to induce railroad companies to give further orders at a price considerably above that of open-hearth rails. Third, the application of the

electric steel furnace for castings, which now attracts considerable attention; it is quite possible that the number of such installations will rapidly increase. The competition between different types of electric steel furnaces is still merrily going on as is evidenced by the news of the last few weeks. Just before Christmas the Heroult furnace at the Harrison works of the Crucible Steel Company of America was put in operation; about the same time the first American steel furnace of the pure Stassano type was started in a southern California foundry, while an order has just been given by a Pennsylvania concern for two Frick furnaces, each of 20 tons—which is large for an induction furnace. In addition, there are several Girod steel furnaces in operation, while the experimental work with the ingenious pinch-effect furnace of Dr. Carl Hering is being continued for steel refining as well as brass and copper melting and very satisfactory progress is reported.

Non-Ferrous Metallurgy

Very much discussed, but not as far advanced commercially, is the use of electrochemical methods in nonferrous metallurgy. Of particular interest at present is the problem of smelting complex zinc ores in the electric furnace, which has attracted many inventors, on which much work and money have been expended, but which seems now to approach a final commercial solution. It is noteworthy, however, that in Western metallurgy the electric furnace is finding now a rather lively competitor in leaching processes, with or without subsequent electrolysis. Much has already been accomplished in the leaching of copper tailings, but much experimental work is also being done on electrolytic zinc.

The hydro-metallurgical treatment of copper ores is rapidly advancing. About a dozen plants are now successfully treating copper ores or tailings by wet methods, and the number will almost certainly increase, for several companies are conducting experiments along this line. As to precipitation, the methods differ, since besides electrolytic deposition, hydrogen sulphide and iron are used as precipitating agents. The interesting plant of the Butte & Duluth Mining Company employs electrolysis with insoluble anodes. It seems not unlikely that this whole development may revolutionize the treatment of carbonate and silicate low-grade ores.

The Electric Zinc Furnace

The statement made above that the electric zinc furnace seems now to approach a final commercial solution is essentially based on the fact that the one great troublesome element in electric zinc smelting—the problem of condensing the zinc vapor to liquid zinc without production of "blue powder"—appears to have been eliminated by a careful scientific investigation of the physical and chemical reasons to which the formation of blue powder is due. The probable success of the electric zinc furnace holds out great hopes for a far more direct treatment of complex zinc ores with improved recovery.

The very great interest which this whole subject attracts was evidenced at the meeting held by the American Electrochemical Society in Denver last autumn, when for the first time Western metallurgists and Eastern electrochemists came together to discuss problems of mutual interest. Quite as interesting had been the spring meeting of the same society at Atlantic City, with its symposium of papers on electroplating, which brought electrochemists and practical electroplaters together for the first time. Both meetings showed that the American Electrochemical Society is successfully fulfilling one of the important functions of every national engineering society, namely, that of a meeting ground where men interested respectively in the practical and theoretical aspects of industrial science come together on a basis of mutual respect and assistance.

Electric Vehicle Progress During 1913

By William P. Kennedy

NOTWITHSTANDING the very pronounced tendency on the part of the purchasing public to refrain from new undertakings involving outlay or investment, the introduction of electric vehicles has continued a steady and healthy progress practically equivalent to that during any similar period in the recent past. This is the most encouraging evidence which could be desired because of the confidence which it must confirm among those interested in promoting the use of this type of machine. However, many of the anticipations current during the earlier part of the year, and which promised to mark a pronounced advance over the accomplishments of the past, have unfortunately not been fulfilled. These were principally an extensive increase in the use of electric trucks by express companies and the probability of the Post Office Department executing its predetermined plan of employing on a large scale electric vehicles in its parcel-post operations. The former has not materialized for conservative business reasons, and the latter was frustrated by the policy of the incoming administration, among the first acts of which was the cancellation of contracts already issued for a considerable number of electric delivery vehicles, which the manufacturers interested submitted to in the belief that by abstaining from an insistence on their rights in the case they would subsequently be favored with equivalent consideration. This has since proved futile, for in spite of the conspicuously superior success with which the other departments of the government have employed the large number of electric vehicles in use, the Post Office Department has persisted in its preference for the purchase and employment of gasoline cars for application well within the range of the electric vehicle.

The electric commercial vehicle has received a great deal of very encouraging attention from the present users of gasoline equipment, prompted by the development of an increased interest in the value of mechanical transportation and a recognition of the evident stability of electric equipment in the hands of large commercial organizations, which are becoming more and more pronounced advocates of its reliability and economy. Skepticism has almost entirely disappeared, and the substantial character of investment already made in this type of car conspicuously attests the conservative confidence which it has earned as an industrial or commercial utility.

Another tendency portending to dissipate the illusion hitherto surrounding the mysterious and unknown characteristics of electric equipment is the extraordinary activity during the past year on the part of gasoline pleasure-car manufacturers to provide their machines with apparatus for starting, lighting, signaling and the performance of other operating functions by

electric means. This is certain to have an extensive educational influence in familiarizing the great mass of automobile users throughout the country with the automatic simplicity and reliability of electrical equipment. It is another step in the direction of a more favorable regard for the electric vehicle upon its own merits and will remove one of the greatest obstacles to its general introduction, which has been the collateral development of the gasoline car.

Another very stimulating influence in the general situation during the year just closed has been the cohesion with which all of the several business groups at interest in promoting the advance of the electric vehicle have united in their common purpose. While the central-station organizations in the larger cities and their vicinity have been remarkably vigorous for some years past, the disposition of many in the medium and minor cities has been apathetic, and in some instances peculiarly indifferent to the project which has such vital possibilities for their individual development.

The result of the collective magazine advertising campaigns subscribed to by a great number of these central-station companies and conducted by the Electric Vehicle Association has perhaps been more pronounced in its educational effect upon the minor central station than upon the prospective purchasing public for which it was primarily intended. This is shown by the vigor with which friendly controversy has been conducted at every opportunity afforded by society and association meetings, where the presumed or acknowledged deficiencies of the contending parties in their conduct or qualification to co-operate for the common good have been a constantly recurring and a burning topic. All of which means that there is a widespread awakening and uprising of that stupendous influence, hitherto dormant, which if once co-operatively harnessed and directed can be exerted so as practically to bring the electric vehicle with great rapidity into almost universal employment.

Pleasure Cars

Conditions surrounding the pleasure-car field have not materially changed during the past year. The cars have continued to be introduced at about the same rate, with perhaps some increased activity in the smaller cities, where the influence of co-operative advertising has had a more pronounced effect than in larger cities.

The design of some of the principal makers has undergone slight changes, these particularly in relation to methods of rear axle drive, but beyond the value of these as constituting a difference or having some supposed merit as talking points in influencing purchasers likely to be swayed by the latest trend of fashion no radical alterations have been effected. Thus we have had changes from bevel-gear to worm-gear drive, when opinion seems to prevail that this is not warranted by any difference of serious character. In fact, some manufacturers, having satisfactory proof from their own critical experiments that mechanically the change was not warranted, have made the change in view of the disadvantage they would suffer in marketing their otherwise "old-style" product in the face of the flagrant advocacy of the "new style" possible with the present-day vigor of advertising presentation.

Similar vagaries have influenced changes in methods of control, although there has been a genuine demand for duplicate-control installations in closed vehicles seating four or more people, so that the machine may be operated from a forward or rear seat as may be desired, there being some advantage in the direction of comfort in operating from the rear seat when the car has only one or two occupants.

There has been considerable inclination to extravagance in the finish and equipment of interiors, which perhaps may stimulate purchase by those able to afford the added price necessary for such refinements. But, on the other hand, this general tendency, prompted by the rivalry of competing manufacturers, has the disadvantage to the trade as a whole of restricting sales within the limitations enforced by high price.

The pendulum has been swinging in this direction so persistently and in such a pronounced manner of late years as to prompt reaction toward a lower-priced vehicle provided with such refinements and comforts as are likely to meet the complete requirements of the more conservative class, whose desires are pronounced in the direction of utilitarianism graced with convenience and respectable equipment rather than any degree of ostentation or extravagance. In fact, since the change to meet this demand has become evident in the production of a few makers of machines of this conservative order we are already beginning to hear announcement of the much-desired "popular-priced electric," which is expected to meet with ready acceptance by the great mass of purchasers to whom such an electric vehicle might become as much of a "necessity" as any of the other modern commercial electric utilities enjoying almost universal employment.

This is a logicai anticipation perhaps often repeated, but it is curious enough, in a somewhat psychological way, that before the public would become satisfied with a moderate-priced electric vehicle, naturally having the restricted though reasonable range of activity—or, in other words, before such a machine could become fashionable—the demand for extreme performance capacity and the extreme of luxury and comfort would first have to be met and satisfied.

Low-priced cars with limited range, but such as would meet the every-day requirements of a business man as a convenient means of locomotion, have been available for many years past, but since they were not fashionable and their limitations were in marked contrast with the commodious and expensive electric de luxe in use by "society," those who did purchase and employ the utility type were made to feel so "cheap" or otherwise handicapped and embarrassed by the contrast as to be impelled to discontinue its service.

Automatic Charging Apparatus

One of the fundamental characteristics influencing the successful and satisfactory employment of electric vehicles is that principle of design which anticipates the detrimental influence resulting from permitting the driver to have free scope in his functions of operating the machine and which consequently predetermines and limits these to a rigid and definite method of control, provided with due regard to a rational application of the power equipment, reasonable acceleration and maximum speed consistent with the loads and traffic limitations under which the machine is to be employed. These fool-proof safeguards are the insurance which gives the electric car its well-defined pre-eminence over the gasoline vehicle wherever the employment of unskilled labor is necessary or desirable in the economy of maintenance and operation.

During the past year there has been commendable development tending to secure similar safeguards in the manipulation of battery charging and providing for the automatic performance of predetermined functions wherever convenience or necessity precludes that constant supervision desirable in cautious or exact charging. Apparatus of this type has made considerable headway, particularly in the installation of private garages attached to residences, where its employment enhances the facility and convenience of the electric carriage as a domestic luxury and comfort.

Instruments

Another refinement in the direction of security has been the development in convenient form of performance-indicating and recording instruments whereby attention and supervision is invited and directed toward those inconspicuous though essential details which largely contribute to precise operation. This, when relieved of its usually attendant tedium, brings a compensation which must be measured in terms above the monetary, since it promotes a mental satisfaction, a conservation of human energy and a preservation of property which are entirely above the purely economic rewards attendant upon mere reduction of expense.

The convenience and precision of these instruments, which visually indicate the existing state of battery charge and make evident the range of the charge and discharge on any particular occasion, convey to the owner of automobile equipment covered by such protection the assurance and satisfaction that his property will be carefully preserved and that the danger of damage to it when not immediately under his supervision is reduced to a minimum. The use of this type of instrument has been of considerable benefit in removing the supposed mystery surrounding storage-battery apparatus and has reduced to definite and accurate indication most of the hitherto unknown quantities involved.

Old Equipment

One strong indication of the stability of the electric commercial vehicle is the absence of second-hand cars upon the market. In other words, they are a good, sound investment and those who buy them keep and use them. Moreover, the fact that they usually remain in the service of the original purchaser makes the pedigree, so to speak, of every commercial electric a matter of easy proof, and consequently whenever used cars appear for sale they are easily disposed of. The principal contributing factors to this situation are well-established design, the practical commercial standardization of minor wearing equipment—batteries, tires, chains, etc.—ready availability of this upon the market, as well as the susceptibility to change or modification of this equipment, permitting some latitude or adjustment of capacity to the performance required.

Use for Parcel Delivery

The year 1913 opened with the very gratifying prospect that the disposition on the part of express companies to increase their electric-vehicle equipment would continue to mature to the point where a complete change from horse to machine equipment would be carried into execution, with the electric equipment largely predominating. That this prospect declined with the increasing activity of parcel-post operation and the imminent inclination of the Interstate Commerce Commission in the direction of regulations adverse to the interests of express organizations was beyond question unfortunate for electric-vehicle interests. It postponed the expected opportunity for making the year just closed a banner one and the entering wedge into that confidently expected era of employment on a large scale of electric vehicular equipment for merchandise transportation. With more than $1,500,000 already invested by express companies in this direction and a reasonable expectation immediately ahead of this being increased to $3,500,000, there can be no doubt of the colossal influence of this investment as an example of confidence to the commercial community.

Although this has not yet become an actual realization, it remains a latent potentiality to be released in the near future irrespective of legislative restriction or governmental transportation operations—assuming the likelihood of express companies remaining in existence. In other words, whatever be the future direction of the activities of express companies—expansion or enforced economy—electric-vehicle equipment must necessarily be increased as their dominating utility for city transportation. The lesson has been taught; the experience has been bought and paid for; the transaction has been a satisfactory one; the fact has been established that when applied within the reasonable limits of their capacity and operated under the direction of their own competent executives, intimately familiar with the peculiarities of the apparatus, there is no more economical and reliable device applicable to their requirements than the electric vehicle.

Electric Omnibus Promotion

During the year there has been more or less resuscitation of the fascinating allurements of electric omnibus operations, particularly in New York. At this recurrence of past performances there have been a few added attractions to lend it some novelty, such as a nickel ride, with stress on the charm of a feminine conductor, and there have been even veiled hints of the oft-prophesied new and revolutionary motor equipment. All of which leads us back over a six-year interval of suppressed activity to those operations of similar character occurring in Detroit, Cleveland, St. Louis, Pittsburgh, Philadelphia and a few other places, as picturesquely portrayed in the New York *Sun*, Aug. 8, 1907, under the title "$8,000,000 Baseless Stock." This will prove interesting reading and a possible antidote at this time against the repetition of any epidemic of the same kind.

The genuine advocates of extension to electric-vehicle operation should lend every assistance and co-operation possible to the furtherance of such undertakings as afford self-evident assurance of the rational application of this type of equipment within the range of its capabilities; but it should not be forgotten that the history of the industry has monumental evidence showing that its progress has been more seriously interfered with in the past by unwarranted expansion in the hands of promoters than by any other cause.

There is abundant evidence available to prove the success possible in the application of the electric vehicle to collective passenger transportation, but the cumulative price paid during the past fifteen years in patient sacrifice of many kinds, in persistent energy, in inactive capital investment, in cautious, progressive development and indomitable perseverance, has been too great and too precious to risk a disruptive intrusion at this period of rapacious projectors of questionable enterprises. Eternal vigilance and unrelenting scrutiny are, in this as in so many other matters, the only dependable safeguards.

Industrial Trucks

Of remarkable significance is the progressive development accomplished during the past year in the application of the small so-called industrial truck in the handling of freight at railroad and steamship terminals, as well as to serve as a general utility in industrial establishments. The significance of this application can be measured only by the conspicuous absence of activity of freight transportation organizations in their terminal equipment and facilities. The introductory period necessary to overcome the reluctance to change existing in such institutions seems to have been passed. The preliminary installation of these devices has given such overwhelming evidence of the economy to be effected with their application as to create an almost immediate demand for their employment in great numbers.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Pennsylvania Railroad Contracts with Philadelphia Electric Company for Energy

The Pennsylvania Railroad has announced orally that the contract for the electrical energy for the electrification of its lines between Broad Street station and Paoli, and also between Broad Street station and Chestnut Hill, has been let to the Philadelphia Electric Company. It was said that probably all of the local trains on those lines would be operated by electrical energy before the end of 1914, and that the first electric trains out of Broad Street station would be running about September next.

The contract is for five years. At the beginning the Pennsylvania Railroad will use about 4500 hp, a minimum of 3750 kw, with a load factor of 25 per cent, being specified. The energy is to be furnished for the main line to Paoli and any addition or extension thereto, the railroad company reserving the right to call on the Philadelphia Electric Company for any additional power that may be necessary for its general system from time to time. With the completion of the present work as planned, the Pennsylvania Railroad will have 32 miles of electrified lines in the Philadelphia suburban district. The cost of the energy to the railroad company for the Paoli line for the first year will be about $150,000.

The Philadelphia Electric Company now feeds a load of 35,000 hp daily for the Philadelphia Rapid Transit Company. Mr. J. B. McCall, president of the Philadelphia Electric Company, said that no change or enlargement beyond the usual will be necessary for supplying the energy for the Pennsylvania lines. At present the Christian Street station has a rated output of 115,000 hp, and during the next year the addition of steam turbines will bring this rating up to 187,000 hp. Until the contract between the Pennsylvania Railroad and the Philadelphia Electric Company is actually signed none of its details will be available for publication.

Engineering Congress at San Francisco, 1915

Col. George W. Goethals, chief engineer of the Panama Canal, has consented to act as honorary chairman of the International Engineering Congress which is to be held during the Exposition at San Francisco, Sept. 20 to 25, 1915, under the auspices of the national engineering societies. The professional sessions of the engineering congress will be divided into eleven sections as follows: The Panama Canal, waterways and irrigation, railways, municipal engineering, materials of engineering construction, mechanical engineering, electrical engineering, mining, naval architecture, military engineering, and miscellaneous. On account of the meeting of the International Electrical Congress to be held at San Francisco during the week preceding the engineering congress, the latter's activity in the field of electrical engineering will be limited to consideration of points of contact between electrical engineering and other engineering phenomena and work. The executive officers of the engineering congress are Messrs. W. F. Durand, chairman; W. A. Cattell, treasurer, and E. J. Dupuy, secretary.

A. I. E. E. Midwinter Convention

The second annual midwinter convention of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York City, Feb. 25, 26 and 27, under the auspices of the electric power committee.

The general subject of the meeting will be "electric power," and each of the sub-committees of this general committee will present papers on the special branch of this subject under its jurisdiction. The subdivisions adopted are: (1) power stations, (2) power generation, (3) protective apparatus, (4) transmission, (5) distribution, (6) economics, and (7) engineering data. In addition to the technical sessions several entertainment features are to be provided by the New York reception committee.

Electrical Equipment for the Chicago, Milwaukee & St. Paul Railway System

After careful consideration, the Chicago, Milwaukee & St. Paul Railway has decided to use the 2400-volt, direct-current catenary system for the electrification of its Rocky Mountain division, as announced in these columns last week.

No decision has been reached with regard to the type of either the passenger or freight locomotives. The freight locomotives will be required to haul a trailing load of 2500 tons up a 1 per cent grade at a speed of approximately 15 m.p.h. The passenger locomotives will be required to handle a trailing load of 800 tons on level track at approximately 50 m.p.h. and on a 2 per cent grade at approximately 24 m.p.h. The heating for trains will be obtained by means of oil-burning steam boilers, for which ample room will be provided.

All the locomotives, both freight and passenger, will be provided with regenerative control. The air brakes will be used only for stops and in emergencies.

Substations

Based upon the investigation of the locomotive performance on the ruling grades in the electrified zone, it has been decided to install in each substation supplying gradients of over 1 per cent an equipment of three 1500-kw units, two being in operation and the third held in reserve.

For gradients up to 1 per cent energy will be furnished from a two-unit substation containing two 1500-kw motor-generator sets, one 1500-kw unit in operation, with the second as reserve. All substation units are to be of the same size and will comprise a sixty-cycle synchronous motor directly connected to two 750-kw,

1200-volt direct-current generators connected in series for 2400 volts.

Energy will be supplied to the locomotives by means of roller contact with an overhead copper trolley wire at least 24 ft. above the rail. The trolley wire will be of No. 4-0 copper and suspended from a steel catenary cable. This catenary construction will be supported by bracket arms extending from wooden poles.

Arnold on Railroad Electrification

Mr. Bion J. Arnold, of Chicago, who has devoted much study for many years to electric-railway advancement in the United States, and particularly the application of electricity to heavy railroading, in his presidential address before the American Institute of Electrical Engineers, at a joint meeting of the (British) Institution of Electrical Engineers and the Institute in St. Louis during the International Electrical Congress in 1904, said that he was convinced that electricity would be generally used on the main railway terminals of the United States and ultimately on the main through lines for passenger and freight service, but that he did not anticipate that it would always be adopted on the ground of economy in operation, nor that it would be introduced through the voluntary acts of the owners of steam railroads except in special instances. He said further that he did not anticipate that all roads would soon adopt electricity, for the steam locomotive would hold its field in this country for many years to come.

To a representative of the *Electrical World* Mr. Arnold stated recently that he thought that the development of electric railroading had proceeded very much along the lines foreseen in 1904. "The great New York Central terminal electrification in New York City," he said, "is practically completed as originally planned, electric locomotives running out as far as Harmon. The New York, New Haven & Hartford has recently extended its electric system by the electrification of several freight yards in the vicinity of New York, and I understand that it plans to extend its system eastward. The Pennsylvania's extensive electrification in and near its New York City terminal is well known. To say nothing of the interesting and extensive electrifications abroad, a mere mention of the examples in the United States would make an instructive list. Such a list, not complete probably, would include the Baltimore & Ohio tunnel in Baltimore, the Sarnia tunnel of the Grand Trunk (the first heavy-duty single-phase railroad system), the Southern Pacific's suburban lines near San Francisco, the Hoosac tunnel of the Boston & Maine, the Great Northern's Cascade tunnel, the Norfolk & Western's mountain division in West Virginia, the Mount Morris (N. Y.) division of the Erie, the Michigan Central tunnel at Detroit, various electrifications of the Pennsylvania near Philadelphia, a mountain division of the Denver & Rio Grande in Utah, and more recently the announced electrification of 440 miles of the main line of the Chicago, Milwaukee & St. Paul between Avery, Idaho, and Harlowton, Mont., over the Bitter Root, Rocky and Belt Mountains. This last is particularly significant, as it presumably means the ultimate electrification of the entire main line of the Chicago, Milwaukee & St. Paul from Harlowton to the Pacific Coast—a distance of 865 miles, including the line to Tacoma.

"To-day there is no question of the practical operating success of moving heavy railroad trains by electrical energy. The whole matter of the application of electricity to railroading is a question of economics—a question as to when and how rapidly the financial burden can be applied to the railroad company so that it can meet it reasonably and fairly. The principal advantage to the railroad of using electricity is increased haulage capacity in addition to some betterment of economy. The latter consideration, however, in many cases is completely absorbed by the increased fixed charges. Thus the expense of making the change is justified, provided the change is brought about no more rapidly than the railroads can undertake the financing.

"I am of the opinion that where a railroad will take the initiative and make the improvement of electrification for the benefit of the public, and where the necessary investment cannot be justified on financial grounds, it is perfectly proper to increase the rates to justify making the improvement which the public demands, provided the increased rate is confined, so far as practicable, to those benefited by the improvement.

The Terminal Problem

"When we consider the important and pressing problem of the improvement of railroad terminals in our large cities, we encounter a fact well known to railroad men, that in many instances the tracks are duplicated or cross and recross each other in such a manner as greatly to increase the fixed charges and operating expenses of the railroad. Much of this tangle could be eliminated by the development of terminals and entrances to cities along economic lines, and if the terminals could be so remodeled the cost of electrifying them would in many instances be greatly reduced.

"I may add that in my report on the rearrangement and development of the steam-railroad terminals of the city of Chicago, submitted to the Citizens' Terminal Plan Committee on Nov. 18, 1913, I suggested certain modifications in terminal arrangement. I pointed out that it is clear that if efficient development is to be expected within the areas now occupied by the railroads in Chicago, the railroads must agree upon a plan of harmonizing individual interests in a broad plan of co-operative development. One feature of the modifications proposed was the through-routing of suburban lines through the city, with connecting stations, so as to permit any section of the suburbs to be reached from any part of the central business district. The tracks should be depressed and covered where necessary and some form of operation adopted by which this would be permissible.

"If the various steam railroads, say in the city of Chicago, could be induced to co-operate to establish such a system of through-routing of suburban trains, a business would be built up which would become profitable—if not at the start, certainly in the course of a few years. The business of railroads is to serve the public, both by their through routes and by their suburban lines. If the existing structures of the latter can be utilized more efficiently in the public interest than at present, then the improvement should be brought about.

"As to the system to be adopted in any railway electrification, there is no invariable rule. The engineer must have before him in each particular case all the factors of the problem before he can come to a decision. Single-phase, three-phase and direct current all have merits for use under certain conditions. It should be said, however, that no large city should allow different systems to be used within its limits; all should insist upon all steam railroads adopting one system, whatever it is, and using it throughout the city."

Purchase of Electrical Energy

One of the live subjects of the year just passed, and one which will continue to be carefully considered in 1914, is whether an electric-railway company can safely

transfer the production of the electrical energy it requires to those who make a specialty of that business, confining itself to its transportation activities. When this question was put the answer was to the following effect:

"It is good economy for the railroad to purchase electrical energy rather than to produce it itself, if an available and efficient electric-service plant is in existence possessing a rating near to or greater than the requirements of the railroad property. An electric-service plant so situated, with the additional railroad load, can operate large generating units and run them nearly at economical load. In other words, such a plant could run its units nearly at the proper rating for economical operation for a greater number of hours daily than could the railroad. In this manner the electric-service plant would be able to reduce the cost per kilowatt-hour for fixed charges and labor compared with what the railroad could hope to do in its own individual plant. Under these circumstances it is more economical for the railroad to purchase energy than to attempt to produce it. By this procedure the railroad would save money and the electric-service company be enabled to make a profit, the amount of each depending on local conditions."

Electric Illumination for Many Community Christmas Trees

Many American cities adopted the plan of erecting community Christmas trees during the recent holiday season. In nearly every case electric illumination formed a conspicuous part of the decorations. Reports from Washington, New York, Boston, Albany, Baltimore, Milwaukee, Columbus, Cleveland, Cincinnati, Detroit, Denver, St. Paul, Minneapolis, St. Louis, Philadelphia, Chicago and other cities gave accounts of celebrations of this description.

In Chicago a 75-ft. built-up tree was erected in Grant Park, near Michigan Boulevard and East Madison Street. This tree was surmounted by an electric-lighted star 3 ft. in diameter, and electric incandescent lamps were also plentifully distributed throughout the branches of the tree. Back of the principal tree was an architectural feature about 200 ft. wide, known as the "trellis." This consisted of a wooden framework concealed by evergreens and arranged in curving form, with wings on each side. There was an arch in each of the side wings and seven smaller arches in the curved portion between. An evergreen tree was placed in each of the large arches and there were seven small trees above the spaces between the arches in the recessed curving portion of the trellis. The whole trellis was about 200 ft. wide and the side wings were about 40 ft. high, the connecting curved portion being about 25 ft. high. Each of the seven small arches contained a triangle supporting eight globes within which were small candles.

CHRISTMAS-TREE DECORATION, CHICAGO

A nearby band stand and the north balcony of the contiguous Art Institute were also especially electrically illuminated. In all, there were about 1100 electric incandescent lamps. This feature of the Christmas celebration in Chicago was due to public-spirited citizens, the Commonwealth Edison Company being a large contributor.

American Economic Association Discusses Public Utility Questions

Public utility questions occupied a large share of the attention of those attending the twenty-sixth annual meeting of the American Economic Association, begun in Minneapolis on Dec. 27. The first session was devoted entirely to the presentation and discussion of a paper on "Control of Public Service Corporations" by Prof. John H. Gray, of the University of Minnesota. President David Kinley, of the University of Illinois, was in the chair, and the attendance at the opening session was about 200.

Professor Gray Attacks Rate Making by Valuation

In presenting a brief summary of a voluminous paper, Professor Gray stated that public service commissions are wrong in making valuation the basis of rate control. He said that public utility commissions are on trial; they will have to win success, or the people will go to public ownership. There is no ground whatever for valuing public utilities. It should be remembered that these utilities are public enterprises in every sense of the word. The relation of the state or sovereign power to them is that of principal and agent. The speaker discussed some of the vagaries of valuations. The rule "a fair return on the fair value of the property used for the convenience of the public" is the finding of the courts. In law the country is now committed to it, but the effort to put this rule into practice leads to chaos.

Private owners are true pioneers. Like other pioneers—say like a man who owns a gold mine—they are unwilling to accept the fair-return dictum of the courts; they still want speculative gains, and they are honest in their belief. The Supreme Court has not laid down any rule for arriving at fair value. Professor Gray ridiculed the cost-of-reproduction-new theory of making valuations. In the last analysis all value ascertained by this method rests on human judgment. The companies, with their combined wealth, hire men of large intellect as experts in rate cases. To such men, in giving their opinion in evidence, more credence is given perhaps than to less able experts representing the side of the public. The speaker cited the Des Moines gas case, where the company is said to have paid $150,000 for expert evidence in a comparatively unimportant case. In the matter of the so-called intangible values the gates are opened for the wildest flights of fancy. Some of these intangible items were reviewed, such as interest during construction, charges for engineering and for general organization, promoters' expenses, contractors' profits, etc. Going value and good will received the speaker's disapproval as elements to be taken into consideration.

The commissions have proved to be but as the fifth wheel to the wagon. The courts have been the controlling bodies. This will continue to be the case until the constitution is changed by a formal action or by interpretation. The theory of principal and agent is the only one upon which to arrive at a satisfactory relation between the public and the utilities. The sovereign state is the principal. After allowing a fair wage to the agency it should have the benefit of all the gains and also stand all the losses. There should be no valuation for rate regulation but history—that is, a statement of outlay of money spent and services rendered—nothing more.

In relation to franchise contracts, Professor Gray gave it as his opinion that the Supreme Court has already discovered that contract ordinances are inconsistent with the modern theories of regulation. He also thinks that "the courts, state and federal, are moving very rapidly to a point where, without any formal reversals, they will find a way to abolish most of the existing franchises by a strained interpretation, which leads to the conclusion that the franchises were invalid from the beginning for lack of power on the part of the municipality."

Early losses should be repaid, but they should not be added to value but rather repaid by higher rates through a reasonable term of years. They should not be capitalized for all time. Professor Gray also declared that the commissions are reviewed by the courts and are not responsible in any proper sense. The courts in their turn are influenced by the findings of the commissioners. The speaker referred to "learned courts and tethered commissions." He cited the Fall River case, where the Supreme Court of Massachusetts not only completely overruled the commission in that state in relation to the issue of stock for extensions where a large surplus existed, but virtually abolished the powers of the commission by ruling that in such matters the commission was acting in a quasi-judicial capacity and must proceed on the same principles as the court would do.

Discussion

Mr. E. W. Bemis, public utility expert, Chicago, urged that courses on rate regulation and the court decisions relating to them be established in universities. He believes that regulation is here to stay and is doing a great deal of good in many directions, such as uniform accounting, control of service, control of rates and the training of men in the study of public-service problems. But regulation has serious dangers. Giving too much of the unearned increment to the companies is one. The state should not ignore the investor, but its chief solicitude should be to protect the consumer. If monopoly earnings are not too large there can be no watered stock. There is great danger, also, in the attitude of commissions toward municipal ownership. The city should have the right to make or lose as it pleases, considering the question of municipal utilities. Mr. Bemis thinks that in relation to regulatory commissions the country is at a stage where it should pause and study.

Prof. J. E. Brindley, Iowa State College, did not agree with Professor Gray that rate-making based on valuation is a fallacy. It is impracticable to fix rates on the basis of a statement of outlay. Some of the statements in Professor Gray's paper were criticised as extreme. Regulating boards should regulate and control, and should not destroy private initiative—"if we are to have private initiative," added Professor Brindley. Professor Gray's principal-and-agent plan, if put into execution, would probably result in poor service, receiverships and state ownerships.

Prof. James E. Boyle, University of North Dakota, said that Professor Gray had presented his criticisms in a striking manner. It was to be regretted that the author did not give more attention to suggesting remedies. At present public ownership of utilities would be a dangerous undertaking. The speaker expressed his belief that private initiative is not due wholly to hope of speculative gains, and he cited the examples of art, literature and science. The plan of one private company owning all the railroads of the country, controlled by the government, and with its earnings guaranteed by the government, looks feasible, but is, perhaps, too radical for the present day. There seems to be an inevitable drift toward public ownership.

Mr. James E. Allison, consulting engineer, St. Louis, and formerly a member of the St. Louis Public Service Commission, thought Professor Gray too pessimistic. He said that the author of the paper set up men of straw to demolish. There is a contractual relation between principal and agent. What that contract is, in the case of public-utility regulations, is the crux of the question. To fix rates there must be a valuation or something to take its place. Original-cost and reproduction-cost valuations often work out about the same.

Prof. William F. Gephart, Washington University, asked if it was indeed true that the time of risk and speculative profits has passed in public-utility enterprises. Utilities that involve risks are planned to-day in large cities and small cities. Commissions do valuable work in improving the character of service as well as in regulating rates. There is a widespread belief that a large portion of public utilities are over-capitalized and charge rates that are too high. This may lead to public ownership, but there will still be difficulties to encounter, for many men believe that governments exist to grant gratuities of some kind. Professor Gephart remarked that there is not much of a constructive character to show as the result of a decade of work by public utility commissions.

Mr. Howard C. Hopson, of the staff of the New York Public Service Commission for the Second District, said that commissions are going back, in making valuations, to the plan based on investment, gradually abandoning the cost-of-reproduction theory. There can be no mathematical formula to be used in working out a rate.

Mr. Roger W. Babson, financial writer, Wellesley Hills, Mass., remarked that theory will have little to do with the settlement of the public utility question. This question will be settled when it is determined who has the larger number of votes, the men who use the utilities or the men who hold investments in them.

In a brief closing speech, Professor Gray declared that commissions have practically arrived at a point where the companies are guaranteed against losses. As to private initiative, he wanted to know if there could be in fact any system of control that would be effective without destroying the opportunity for private gain.

Joint Meetings with Sociologists

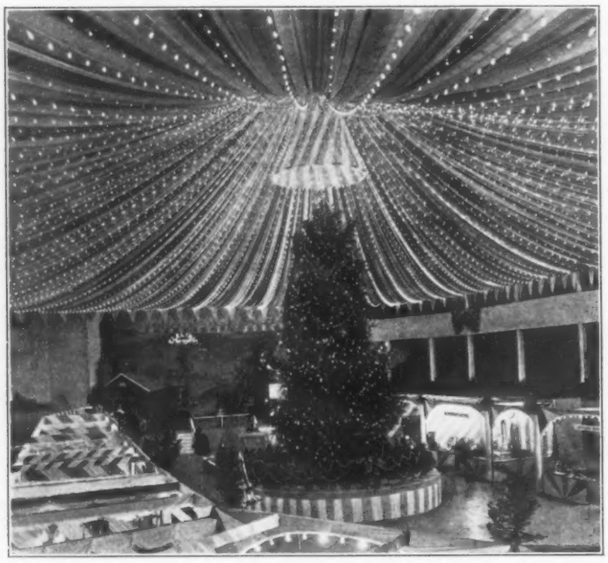
The American Sociological Society held its eighth annual meeting in Minneapolis on Dec. 27-30, the date of the convention of the American Economic Association. A joint meeting of the two organizations was held on the evening of Dec. 27. President Albion W. Small (University of Chicago) of the Sociological Society depicted in idealistic terms "A Vision of Social Efficiency." President Kinley of the economists took as his subject "The Renewed Extension of Government Control of Economic Life." He considered present-day economic tendencies and analyzed the effect of welfare legislation, minimum-wage laws, dissolution of trusts, increased taxation on accumulations of wealth and similar evidences of the apparent desire of governments to protect the weak against the strong in industrial affairs.

"Fos Festival" at St. Joseph, Mo.

Applying the rules of simplified spelling to the Greek word "phos," which means "light," a "Fos Festival," or carnival of light, was conducted by the St. Joseph (Mo.) Railway, Light, Heat & Power Company during the weeks preceding Christmas, and proved a great success in stimulating electrical interest locally.

The twenty-one booths at the show, occupied by manufacturers of electrical apparatus and appliances, electric-vehicle builders, local contractors and the electric-service company, were decorated uniformly, the color scheme of the entire Auditorium, where the exhibit was held, being carried out with streamers of white and green bunting illuminated by strings of lamps of the same colors.

Among the direct results of the show was that more than 175 appliances were sold outright, seven of these



AUDITORIUM, ST. JOSEPH, MO., DURING "FOS FESTIVAL"

being household electric ranges. Electric-vehicle men about the show seemed enthusiastic over the "live prospects" they had encountered. A motor-driven tower wagon was sold to the street railway company and a light truck was purchased by a local laundry man.

Striking illuminating effects were used in the Auditorium. A night picture herewith shows the 40-ft. revolving Christmas tree with its 1500 green incandescent lamps, and also shows some of the 14,000 tungsten lamps which were used in the decorations about the interior of the building. The streamers of bunting and lamps radiating from the bell in the center of the room were alternately green and white.

Streets leading to the Auditorium were decorated by arches bearing the words "Fos Festival," and by streamers of single tungsten lamps strung over the roadway. These festoons terminated in electrically lighted Christmas trees supported on temporary lighting standards bearing 300-watt green and white tungsten lamps.

In the booth of the central-station company at the Auditorium various appliances and lamps were connected to an electric-sign flasher and to an ammeter calibrated to read directly in cents per hour, so that as each appliance was in turn connected, the meter showed the hourly cost of its operation. Placards and ingeniously placed pilot lamps pointed out which devices were at the time in use and which would be next connected.

Standardization of Public Utilities Service

Dr. Edward B. Rosa, chief physicist United States Bureau of Standards, delivered an address before the section on social and economic science of the American Association for the Advancement of Science at Atlanta, Ga., on Dec. 31, 1913. His subject was "Standardization of Public Utilities Service." Dr. Rosa discussed the present relation of the Bureau of Standards to public utilities and public service commissions. Part of his remarks follow:

An important work may be done in standardizing public utility service, not with a view of requiring all companies to conform to one standard, which would be impracticable, but to have standards that can be adapted to different conditions and that can be used to judge the performance of any given utility.

Obviously, however, no single state commission could undertake to establish such standards of efficiency and performance for all the utilities under all the different conditions found in practice. Neither can it be expected that the utility companies themselves will ever formulate such standards. The only practicable way of accomplishing the desired result is by co-operative effort between the commissions and the utilities of the whole country. And the most practicable way of securing such co-operation appears to be for the federal government to assist in the undertaking. The federal government through the Agricultural Department, the Geological Survey, the Bureau of Mines, the Public Health Service, the Bureau of Education and other bureaus and departments is co-operating with the states in many important lines of work, and such work is done by the federal government, not because the states cannot do it, but because the federal government can do a certain part of it much better than the states, and the co-operation and unity of effort thus brought about are of great value to the country as a whole.

Work of the Bureau of Standards

In the same way the federal government has been co-operating to some extent through the Bureau of Standards with the state commissions and the utility companies in the standardization of practice and of service, but the limited resources of the bureau have permitted only a very limited activity thus far. The need of more extended work of this kind has been so generally felt that the Secretary of Commerce has asked Congress for a larger appropriation for this work, and the national association of state commissioners, and individual commissions as well, have expressed the hope that the appropriation will be granted.

The Bureau of Standards would in that case be able to maintain an able staff of engineers and experts who could carry on investigations that would be of value in the work of regulating intelligently and justly the various utilities. It could serve as technical adviser to the state commissions in so far as they chose to avail themselves of its services, and it would act also as a court of appeals for the utility companies in technical questions. It would, of course, have no legal jurisdiction over any utility, and so would not infringe upon the prerogatives of the state commissions. But the moral influence of its opinion might be of some value to a commission when the public was expecting the impossible or a utility was demanding too much, or to a utility that was required by order or by ordinance to do what was unreasonable.

It would be unsafe to predict exactly what could or could not be done by the Bureau of Standards along the lines indicated, but it seems safe to believe that its work would be as well done and prove as valuable and as satisfactory as the work of this kind that it has done

during the past three years. This work has been carried on in a scientific spirit, with no bias for or against the utility companies, with the closest co-operation of engineers and operators of long experience, and with no ambition save to do work that would be of value and that would merit the commendation of unbiased judges.

It appears certain that a large activity of the bureau in the field of public utility regulation, studying the problems coming before state commissions and municipal regulating bodies open-mindedly and yet conservatively, serving as a clearing house of information as well as an agency for investigation and the formulation of results for general use, would be productive of valuable results which would more than justify the cost.

Many of the state commissions recently established have abundant authority but very limited funds to provide an engineering staff. The work of appraisal and inspection is expensive, and the states will have to grant considerable sums for this work even if the federal government co-operates with and assists the state commissions in the way and to the extent proposed. Some state commissions with large appropriations and considerable engineering staffs will require a minimum of assistance from the federal government; but most of the states, at least at the start, are finding great need of such assistance and have expressed the keenest interest in the plans of the Bureau of Standards and a hope that Congress will make it possible to realize these plans.

Rates and Appraisals

The consideration of rates charged for public utility service may be divided into two parts: First, what average rates must be charged in order that the company may have sufficient revenue to pay expenses, provide for maintenance and depreciation, set aside something for surplus or sinking fund, and pay the necessary dividends. Second, how shall these charges be distributed among the different classes of customers for the different grades of service; in other words, what scale of charges is equitable, supposing the total necessary income or average charge for service has already been fixed.

To illustrate, in some places where the charge for electrical energy is 10 cents per kw-hr. for the ordinary small user of energy for lamps and motors, the prices are scaled down as the quality and load-factor are increased (and according to the effect of the load on the station's diversity factor) until for the largest users it is sometimes as low as 2 cents and even in some cases 1 cent per kw-hr. On the other hand, the price of gas to different customers seldom varies by so great a ratio as two to one, and often the rate is the same to all customers regardless of quantity or cost of delivery. There are good reasons why the difference should be less for gas then for electricity, but there appears no sufficient reason why practice should vary as much as it does in different places either in gas or electric rates.

Much intelligent study has been given to the subject of rates, especially by the utilities and a few state commissions, but there is still much difference of opinion concerning both the theory and the practice. Rates are fixed with regard to other considerations besides the cost of the service and the evaluation of such considerations as well as of the cost is difficult indeed. Improper discrimination in electric rates should not be allowed, but a proper discrimination or differentiation is necessary. How to distinguish between what is proper and improper is the main question. It is of great importance that the state commissions co-operate in their study of the problem, and as far as possible adopt uniform methods of determining rates; and the utility companies should welcome such study.

Some engineers regard rates as a very delicate subject and deprecate any investigation that might tend to disturb present conditions. But no one need flatter himself that under any system of efficient public service regulation the subject of rates can be kept in the background. To suggest that it is too delicate to be studied in the open creates the suspicion that there is something to conceal. When there is adequate regulation such a study would be made from the standpoint that whatever hurts the utility company hurts the public, and a system of rates that permits the company to build up its business enables it to give better service to all its customers. In other words, where regulation is adequate and just the interests of the utility and of the public are one, namely, to adopt rates which are just and equitable and which will contribute to the maximum degree to the development of business.

Appraisals are often necessary in connection with the fixing of rates. Generally appraisal engineers are employed by state and city commissions to do this work. As the company whose property is being appraised is necessarily represented in the work, it is desirable that the commission be represented also. The appraisal engineers aim to be just and unprejudiced. To secure the best results it would appear that the commission should be represented by one or more experienced engineers not connected with the appraisal firm. These may be engineers belonging to the commission's permanent staff or they may be engaged for the occasion. Methods and unit values employed by different appraisal engineers should be compared and studied, and as far as possible uniform methods formulated.

The rest of Dr. Rosa's remarks, dealing with other aspects of public utility regulation, will be published next week.

Public Service Commission News

Illinois Commission

The City Council of Chicago passed a resolution on Dec. 29 empowering the law department of the city to bring a suit to test the validity of the act creating the Illinois State Public Utilities Commission. The suit will be instituted to determine whether or not the new commission shall have the right to regulate companies operating within the city of Chicago.

Ohio Commission

Testimony in the first case of valuation for rate-making purposes has been heard by the Public Service Commission of Ohio. Owing to the large number of unexpected issues that came up, the case has been continued until later so as to provide an opportunity for study of some of the points. All of the larger companies in the State were represented at the hearing in order to take part in the discussion of the principles involved. The company directly concerned in the case is the Bucyrus Light & Power Company.

The city of Bucyrus passed an ordinance fixing rates at which the Bucyrus company should furnish energy for light and power. The company objected to the figures and the matter was taken to the commission. Representatives of the commission made an investigation and valuation, while experts representing central stations in various localities have done the same.

One of the first points of contention related to the items that go to make up overhead charges, and on this question testimony was given by Messrs. H. S. West and W. W. Pollock, Cleveland; Mr. F. McCrackin, of the Ohio State University; Mr. V. N. Gurney, of the National Gas & Electric Company, and Mr. L. B. Denning.

Current News Notes

NATIONAL AUTOMOBILE SHOWS.—The National Automobile Shows given under the auspices of the Automobile Chamber of Commerce, Inc., will be held at the Grand Central Palace, New York City, Jan. 3-10, and at the Coliseum and the First Regiment Armory, Chicago, Jan. 24-31. Both shows will have on exhibition passenger cars, motor cycles and accessories.

* * *

OHIO ELECTRIC VEHICLE CENSUS.—More than one-third of the electric automobiles in Ohio are owned by residents of Cleveland, according to State Registrar Shearer, who has completed a part of his annual report. In Cleveland there are 1880 electric vehicles, while the total number in the State is 4115. In 1912 there were only 3610 electrics in the State. The receipts for license tags for these cars in 1913 amounted to $12,345.

* * *

NEW ELECTRICAL CODE OF THE CITY OF NEW YORK.—The Department of Water Supply, Gas and Electricity of the city of New York has just issued its 1913 edition of the Electrical Code of the City of New York. This differs from the National Electrical Code in some respects. In the 1912 edition there were about 110 differences, whereas in the present edition there are only thirty-five differences. Some were changes of phraseology, others were due to local laws, and a few were honest differences of opinion based upon experience in New York City.

* * *

ELECTRIC PLANT IN ARCTIC CIRCLE.—The first electrical plant to relieve the Arctic darkness, which will be erected at the Episcopal Mission at Point Hope, will be designed, built and equipped by Dr. W. E. Temple, head of the electrical engineering department of the University of Pennsylvania. The site on which the plant will be erected will be 100 miles north of the Arctic Circle. A huge windmill will be the prime mover, as the velocity of the wind at Point Hope is said to be rarely less than 20 miles an hour, but an auxiliary gasoline motor is to be installed. The mission at Point Hope contains about 400 inhabitants.

* * *

ITALIAN EDUCATOR'S TRIBUTE TO NEW YORK'S "WHITE WAY."—The thing that appealed must notably to Dr. Maria Montessori, the famous Italian educator, on her first visit to America was the illumination of the city streets. She said: "When I came into New York harbor, I was amazed, dumbfounded. But when I drove through the streets words would not show my feelings. I imagined for a moment that a great festival must have been under celebration, and I emphatically declare that the greatest emperor of modern times could not enter Italy under such wonderful illumination. What could I say when I found that turning night into day was only the usual thing in the great cities of your wonderful country?"

* * *

SPECIAL COURSE IN TELEPHONE ENGINEERING AT LEWIS INSTITUTE.—A special course in telephone engineering, to consist of evening lectures, will be given at Lewis Institute, Chicago, beginning Jan. 5. The work will be in charge of Prof. Arthur Bessey Smith and Mr. Fred R. Quayle, engineers of the Automatic Electric Company, Chicago. Students entering the course are required to have a working knowledge of the fundamental principles of alternating currents. The course will be given on Monday and Wednesday evenings and will comprise twenty lectures, beginning with "Speech Transmission, Acoustics and Switching," followed by "Transmission by Local Battery," and proceeding with lectures relating to both manual and automatic systems, the twentieth lecture being entitled "Toll Boards, Including the Working of Manual with Automatic."

* * *

EXAMINATION FOR ASSISTANT ELECTRICAL ENGINEER.—A civil service examination for assistant electrical engineer of the Public Service Commission of the First District of New York will be held on Jan. 17. Applicants must have had at least seven years' engineering experience in electric railroad work, preferably with rapid transit or heavy electric traction lines. Appointees will have to handle a considerable amount of work in connection with theoretical computations on the design of electric railroad equipment, and should be familiar with and experienced in the design, selection and installation of electric railroad motors, etc. The position carries with it a salary of from $1,801 to $2,100 per annum. Applications must be sent not later than Jan. 7. Address New York State Civil Service Commission, Albany, N. Y.

* * *

SERVICE IN DENVER AND PUEBLO COMPLIMENTED.—During the first week in December that part of the State of Colorado contiguous to Denver was visited by one of the most severe snowstorms in its history, trying the souls of public officials and especially of the public utilities. The Denver *Post* in its issue of Dec. 8 complimented the Denver Gas & Electric Light Company by printing the following appreciation on the front page: "For the people the *Post* wishes to express their thanks for the very excellent and uninterrupted efficient services of the gas and electric-light and telephone companies during the storm." The Pueblo Commerce Club also sent a letter to H. M. Byllesby & Company complimenting the Pueblo management of the Arkansas Valley Railway, Light & Power Company for the service given during the snowstorm in Pueblo and other Colorado cities.

* * *

SOCIETY MEETINGS

NORTHWESTERN CEDARMEN'S ASSOCIATION.—The annual meeting of the Northwestern Cedarmen's Association will be held at Escanaba, Mich., Jan. 27 and 28. Mr. H. E. Boucher, 743 Lumber Exchange, Minneapolis, is secretary of the association.

* * *

WESTERN SOCIETY OF ENGINEERS.—The annual meeting and dinner of the Western Society of Engineers will be held in the Red Room of the Hotel La Salle, Chicago, Jan. 7, 1914. On the following evening, Jan. 8, there will be a smoker and meeting in the rooms of the society, 1735 Monadnock Block, Chicago.

* * *

JOINT MEETING OF JOVIAN ORDER AND ELECTRIC CLUB, CHICAGO.—Acting upon invitation, members of the Electric Club had luncheon with the Jovian Order at the Hotel Sherman, Chicago, Dec. 29. After the meal Mr. Homer E. Niesz, chairman, introduced Mr. E. E. Rines, of Peoria, Ill., who announced that through the efforts of the Jovian Order in Peoria an electrical show would be held in that city March 9 to 15, 1914. In a few brief remarks, Mr. C. B. Scott, of the bureau of safety of the Middle West Utilities Company, outlined the work of the bureau in protecting the company's men and its apparatus from accidents and in establishing safe operating practice. The speaker of the day, Mr. Alexander Shane, told how the co-operation of the workmen in the various departments of the Middle West Utilities Company was being sought. He stated that the fundamental principle underlying accident prevention was to be found only in educating the men to protect themselves.

The 150,000-Volt Big Creek Development—I

World's highest operating voltage employed to transmit 120,000 kw from the high-head plants of the Pacific Light & Power Corporation to the city of Los Angeles, 240 miles distant

On account of the hydraulic head utilized, the amount of power developed, the distance and voltage of transmission and the provisions for regulation upon the lines, the recently inaugurated Big Creek development of the Pacific Light & Power Company, of Los Angeles, Cal., represents one of the most advanced contributions of the engineer to the welfare of civilization, illustrating on its economic side the most skilful conservation of natural resources and on its technical side the solution of problems on an unusual scale even for the Pacific slope.

Although the exact opposite of the great development at Keokuk as regards hydraulic features, the Big Creek installation stands in the same class of great engineering undertakings for electrical supply placed in operation in 1913. Preliminary service was begun on Nov. 8 without a single hitch in the operation of the system, about 18,000 hp being transmitted over the first of two high-tension lines between Big Creek and Los Angeles at a test pressure of 135,000 volts. The lines are designed for 150,000-volt service and will transmit an aggregate of about 160,000 hp. They will be completed in the near future. The entire project has been designed and constructed for the Pacific Light & Power Corporation in less than two years by the Stone & Webster Construction Company, of Boston, Mass.

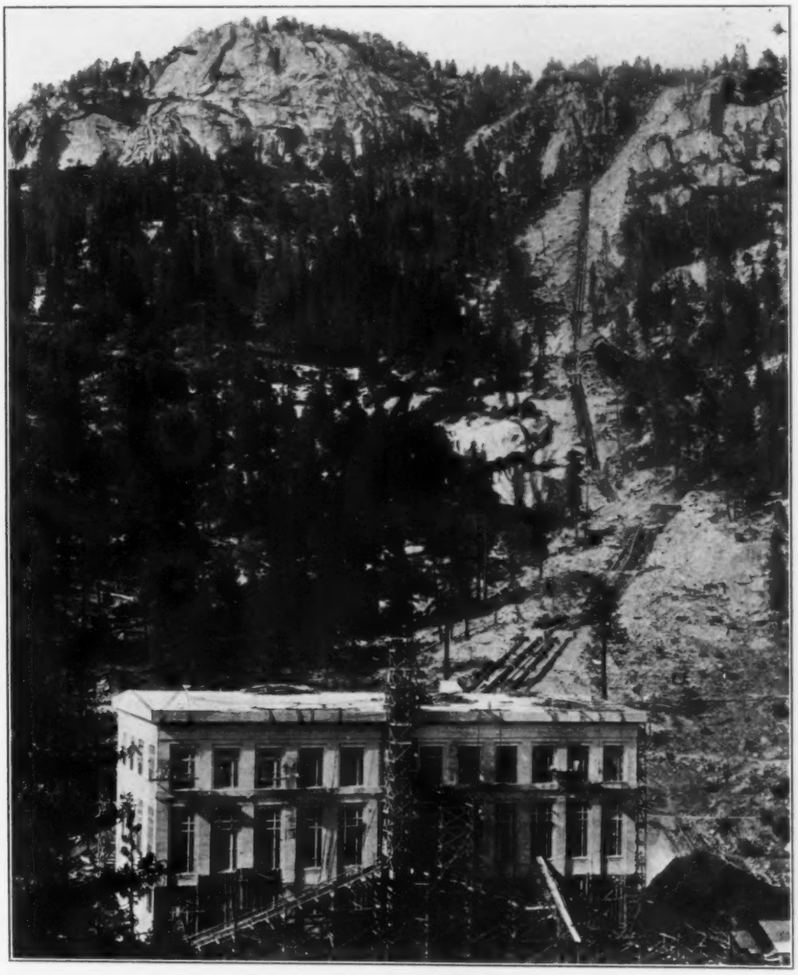


FIG. 1—POWER HOUSE NO. 1, BIG CREEK DEVELOPMENT, PACIFIC LIGHT & POWER CORPORATION

Location of Development

The development is located in the Sierra National Forest, about 70 miles east of Fresno, and the permit granted by the United States Department of Agriculture for the project is the largest ever accorded by the government. Ultimately four power houses, two reservoirs and 25 miles of concrete-lined tunnels will be built. The permit covers the development of 350,000 hp, allowing twelve years for the complete work. The initial step in the development comprises the installation of two power houses, four concrete dams, two tunnels, two 240-mile transmission lines of the steel-tower type, substation and switching-station facilities, and a 56-mile standard-gage railroad. The general plans were outlined in the *Electrical World* of Sept. 7, 1912, page 480, and the development has been pushed along the general lines there described. A notable record for rapid construction was made in connection with the railroad, which was built through mountainous country in 165 days, including the work of location, purchase of rights-of-way, the securing of government permits and actual construction.

Big Creek, with its tributaries, rises in the Sierra Nevadas and drains an area of about 88 sq. miles, the watershed being at an elevation of over 7000 ft. at all points. The annual rainfall is over 80 in. and the run-off about 50 in. Big Creek has a fall of about 4000 ft. in 6 miles from a natural basin in the mountains above Big Creek Falls. This drop is utilized in two plants, the effective heads on the wheels being 1900 ft. for Plant No. 1 and 1780 ft. for Plant No. 2. The average daily flow is about 300 cu. ft. per second. In the natural basin a reservoir with an initial capacity of about

53,000 acre-ft. has been formed by the construction of three dams built to an elevation of 6915 ft. By raising the dams to an elevation of 6965 ft. the capacity of the reservoir will be increased to about 120,000 acre-ft. The utilization of this increased storage capacity with the natural flow of the stream will require the ultimate installation of at least four units in each plant, two of

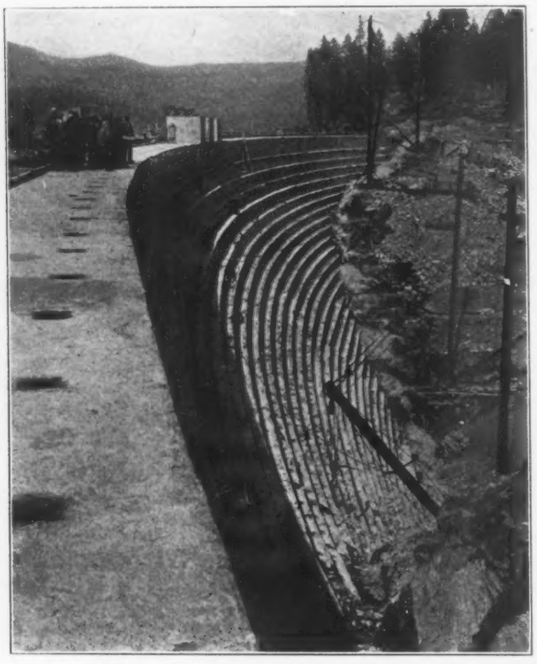


FIG. 2—DAM NO. 1, THE LARGEST OF THREE AT THE UPPER BASIN

which are being installed for the initial development.

The mountains which mark the northern and eastern boundaries of the reservoir rise to elevations of 10,000 ft. and 11,000 ft., with only a small section below 9000 ft. The southern and western divides are comparatively low and offer little obstruction to the warm, mois-

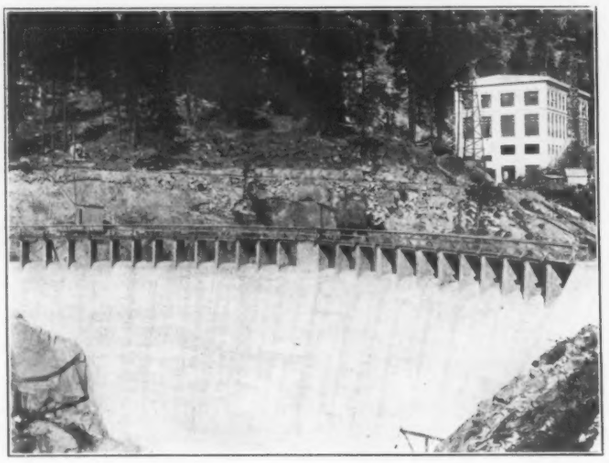


FIG. 3—DAM AT POWER HOUSE NO. 1

ture-laden winds from the Pacific, which are unable to cross the peaks to the north and east without a heavy precipitation. The completed reservoir is to be 6 miles long, 1.5 miles wide and about 150 ft. deep. On account of the high heads developed it is estimated that this storage reservoir will carry 120,000 kw at 50 per cent load-factor for 240 days.

Dams and Hydraulic Features

The three dams at the basin outlets are concrete and masonry structures of the gravity section type, the largest dam, No. 1, closing the discharge of the basin to Big Creek itself. This dam is 132 ft. high to the crest, 812 ft. long on top, and contains 59,000 cu yd. of cyclopean concrete. It is built with straight ends and a curved center section, arched on the upstream side. The upstream face is vertical, the downstream face being built with steps to give a better bond for the new concrete when the dam is raised to its ultimate height.

The present dam is 80 ft. thick at the base and 12 ft. wide at the top, provision being made for flashboards 5 ft. high. In the ultimate development the dam will be 119 ft. thick at the base and 16 ft. wide on top; the vertical upstream face will be continued, and the downstream face will be straight, except for a vertical curve of 72.5-ft. radius from the crest about 40 ft. downward. The other two dams are of the same general design, one containing 27,200 cu. yd. and the other 31,300 cu. yd. of masonry, the lengths being 1015 ft.

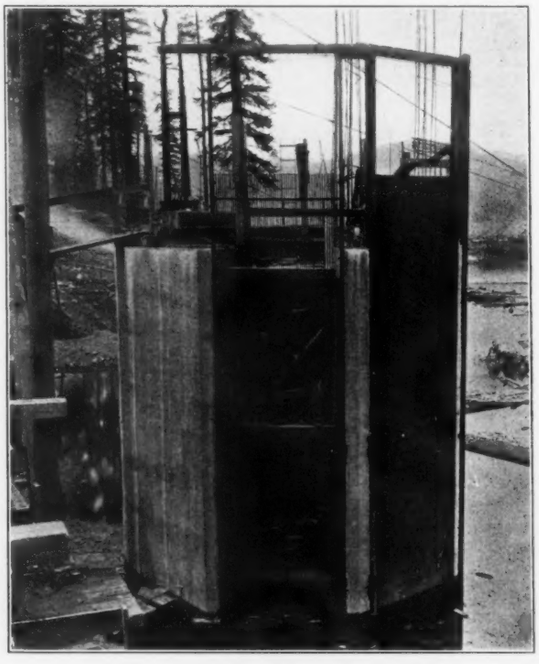


FIG. 4—INTAKE TO TUNNELS

and 450 ft. Granite is the characteristic structure of the mountains around the development and the dams all rest upon solid foundations of this material, the depth of excavation below the original ground surface varying from 20 ft. to 90 ft.

Discharge Tunnel and Pipe Lines

At No. 1 dam the water is drawn into the conduit system through an intake tower. The latter is of reinforced concrete 104 ft. high and 20 ft. in inside diameter built near the northerly end of the dam. On its upstream faces the tower is provided with three sets of screens 7.5 ft. wide and extending to the top of the tower, which has walls 2 ft. thick. The screens are provided with motor-driven rakes covering their entire area. In the center of the rear wall of the tower is the 9-ft. outlet to the discharge tunnel, equipped with a heavy gate of the Coffin type, operated from the top of the tower through two stems. The gate can be opened or closed against a head of 140.5 ft., corresponding to the ultimate height of the dam. The disk of the gate is of cast steel and the frame is of cast iron, all wearing

surfaces being of bronze. Just above the main gate is a 24-in. by-pass gate by which the water pressures in the basin and tunnel can be equalized when the main gate is shut. The by-pass gate discharges into a 36-in. air shaft extending from the top of the tower to the tunnel, and a ladder is installed in the shaft to facilitate inspection of the tunnel.

FIG. 5—84-IN. FLOW PIPE

There are three 42-in. hand-operated sluicegates in the center of the dam, by which the reservoir can be emptied. Racks are provided in front of the gates for screening service.

The discharge tunnel, 3880 ft. long and 12 ft. in diameter, connects at its lower end with a 108-in. pipe line. The pipe extends 400 ft. into the tunnel and the section of tunnel containing it is concrete-lined and large enough to permit inspection of the outside of the pipe. Outside the tunnel portal the 108-in. pipe connects with a steel-plate Y having two 84-in. outlets, one of which is blanked for future service.

Four main units aggregating 80,000 hp in generating plant No. 1 will be supplied with water by one 84-in pipe line. This pipe is laid on a grade of 7.5 ft. per 1000 ft. and is 6480 ft. long from the tunnel outlet to

FIG. 6—PENSTOCK ON HILLSIDE, PLANT NO. 1

the top of the canon in which the plant is situated. The pipe line is carried on concrete saddles placed 35 ft. apart, and the elbows are anchored by reinforced-concrete blocks. An earth covering of 12 in. minimum is placed throughout the line. Manholes are provided at 2000-ft. intervals. The 108-in. pipe has a steel shell 0.5-in. thick, with double-riveted longitudinal and single-riveted circular seams, a shoe plate being provided on the outside courses for sliding the pipe into the tunnel. The 84-in. pipe varies in thickness from $\frac{3}{8}$ in. to $\frac{1}{2}$ in., the longitudinal seams of the thinner plate being part double-riveted and part triple-riveted according to local conditions, while those of the thicker pipe are double-riveted.

FIG. 7—INTERIOR OF GENERATOR ROOM

At the top of the slope and 1942 ft. above the first generating station the flow pipe opens into four 44-in. outlets, each two of which will connect with a penstock leading to the generating units, the others being blanked. Near the top of each penstock is a 42-in. gate valve equipped for both hand and motor operation with remote control from the power house. Just below the gate valves are two 24-in. standpipes, one in each line. These standpipes extend up the mountain side a distance of 425 ft. and terminate in two vertical surge tanks 3 ft. in diameter and 35 ft. high. The tanks are anchored into concrete foundations, 10 ft. deep, 7.5 ft. wide at the top and about 11 ft. wide at the bottom, by four cast-iron brackets held in place by foundation bolts 5 ft. long. The

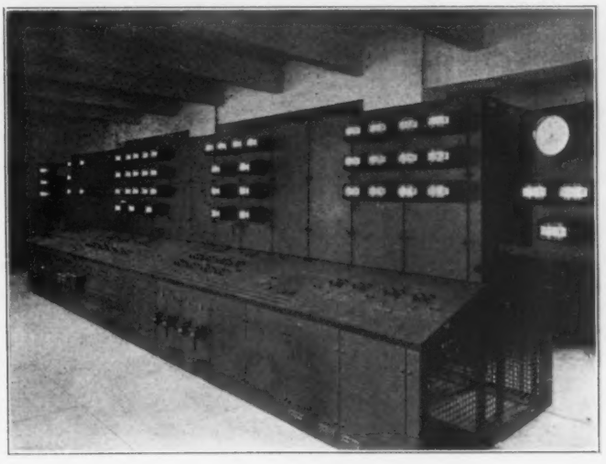


FIG. 8—BENCHBOARD AT STATION NO. 1

tanks are cross-connected by steel latticework near their tops.

The two penstocks run parallel at a distance of about 7 ft. to a point 800 ft. above the power house, where each divides into two 26-in. pipes, each smaller pipe serving one runner of a waterwheel unit. The penstocks are built in 30-ft. sections of lap-welded steel

pipes varying in diameter from 42 in. at the top of the slope to 24 in. at the wheel inlets, the thickness ranging from 3/8 in. to 1 3/16 in. The circular joints are riveted for pressures up to 1460 ft., but for greater pressures are flanged and bolted.

Each main unit consists of a 175,000-kva generator directly connected to two impulse wheels of 10,000-hp rating each, the wheels being overhung outside the bearings carrying the shaft. Apart from operating under one of the highest heads thus far developed, these wheels are the largest of their type ever built. They are 94 in. in diameter on the impulse circle and each contains nineteen cast-steel buckets held in position on a nickel-steel wheel disk by three pressure-fitted bolts. The water for turning the wheel disks is directed upon the buckets by means of a stationary nozzle with a governor-controlled needle valve.

Regulation of each unit is obtained by two oil-pressure governors, each of which independently controls the movement of one needle valve. The shaft speed may also be controlled by manipulating the governors by hand, and the needle valves are also connected with a remote electric speed control operated from the power-house switchboard. The governor arrangement permits operating either wheel of the unit without the other at the maximum efficiency, so that fractional loads can be handled with economy.

Each of the governors operates a pressure regulator which automatically by-passes the water at times when the needle is closed with an automatic adjustment providing for slow closing in order to prevent excessive rises in pipe-line pressure. The pressure regulator is connected to the inlet pipe back of the nozzle, and when adjusted to act as a water-saving device it will open for a given pressure rise, closing automatically only when the pipe-line pressure returns to normal. The regulator has the same discharge capacity as the nozzle, the water issuing from it having its velocity reduced by an energy absorber, after which it flows into the tailrace below the main wheels. The tailrace is lined with steel to take care of the erosion which otherwise would result from the discharged water.

The weight of the impulse wheel disk, the reacting force from the jet striking on the buckets with a velocity of 300 ft. per second, and the weight of the generator rotor are all carried on two 20-in. by 64-in. ring-oiling, water-cooled, self-aligning babbitted bearings. The main shafts are of hollow, forged nickel steel, 20 in. in diameter at the journals and 27 in. in diameter at the rotor, their over-all length being about 29 ft. The normal speed of each unit is 375 r.p.m. All governors and main bearings are supplied with oil from a system of piping connected with a central plant in the basement, the apparatus of which is in duplicate. There are two 2½-in. rotary, single-stage oil pumps arranged for both electric and hydraulic drive and equipped with suction and pressure tanks. It is planned to operate the pumps by motors for the greater part of the time.

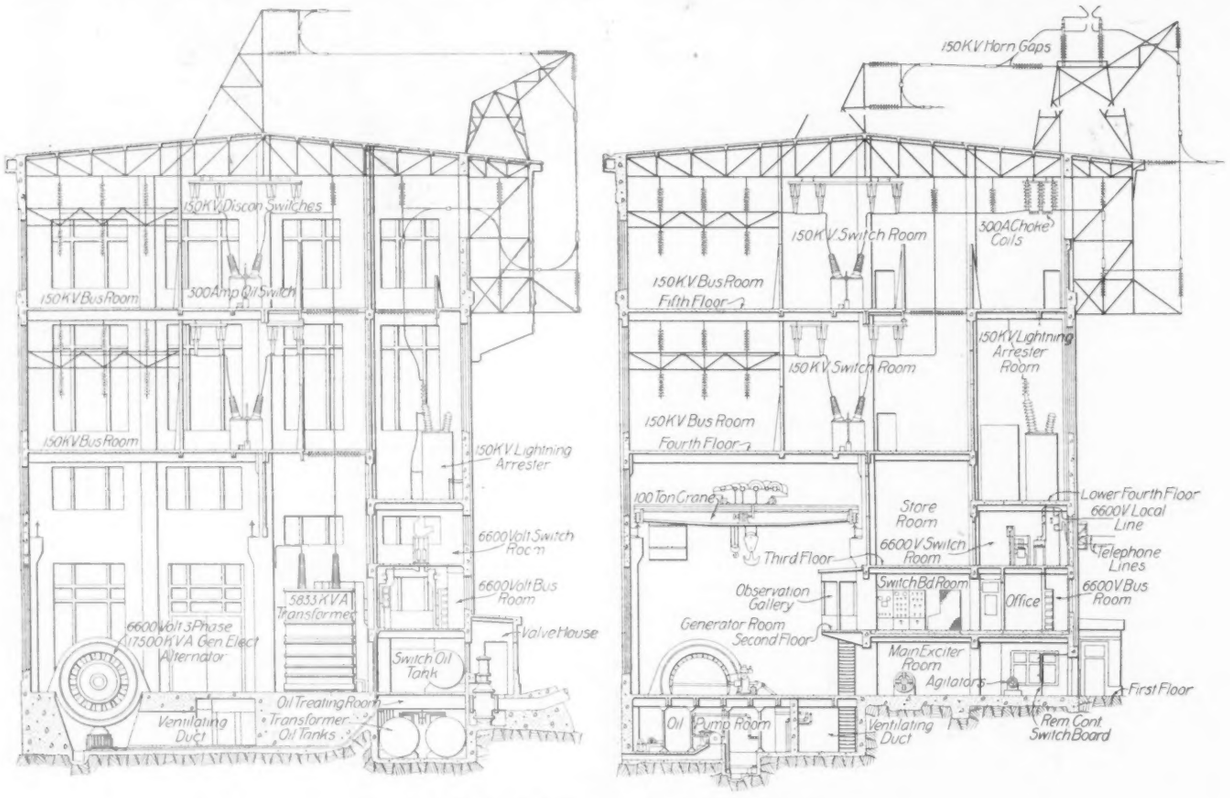


FIG. 9—CROSS-SECTION OF POWER HOUSE

The oil flows from the suction tanks to the pumps, where its pressure is raised to 200 lb. per sq. in. It flows into the pressure tanks and thence to the operating valves and cylinders of the governors, returning to the suction tanks through filters. By means of an automatic by-pass valve the oil is merely circulated through the piping system when the pressure exceeds a predetermined value, so that the motors are not obliged to run at maximum output except when the pressure is below normal. The lower side of each main bearing is connected to the pressure side of the oiling system through a reducing valve, so that forced lubrication can be had when starting the unit, this being discontinued after the oil rings attain sufficient speed to take care of lubrication.

Each governor is provided with a load-limiting device so that each wheel cannot furnish more than a predetermined amount of power. This device allows the

governor to close the gates when the speed goes above normal and when the demand upon the wheel is less than that of the maximum for which the governor becomes blocked. A safety device is provided to close the needle valve in case of breakage of the belt driving the governor fly-balls. The valves for controlling the water supply to each nozzle are hydraulically operated and are of special design to meet the high head involved. Their operation is safeguarded by providing a hand-operated pump to supply water pressure at times when a pipe line may be empty.

Two exciters are at present installed, both being designed for ultimate combined motor and waterwheel drive. In the initial installation one exciter is motor-driven and the other is hydraulically operated. The wheel design provides for a single runner 47 in. in diameter with twenty-four buckets inclosed in a steel-plate housing, the generator being mounted on a horizontal shaft with a common bedplate. The maximum jet diameter is 1 5/16 in. and its speed 300 ft. per second.

The exciter wheel nozzles are stationary, with hand-adjusted needle valves. Speed regulation can be obtained by either hand manipulation or automatic governor control, and when the load decreases the jet is deflected from the buckets by a steel hood operated by the speed-controlling devices. The water for the exciter wheels is supplied by an 8-in. header pipe cross-connecting the four pressure lines, each wheel nozzle being served through a 6-in. branch. The valves are designed for a working pressure of 1000 lb. per sq. in., all having been tested to 1500 lb. Each weighs 20,400 lb. and all are located in a special valve house adjoining the main power station building.

FIG. 10—GENERAL PLAN OF SITE

Generating and Switching Equipment

The generating equipment, electrical apparatus and high-tension buses are housed in a reinforced-concrete and structural-steel building measuring 171 ft. long, 84 ft. wide and 103 ft. high. On the first floor are the generating units, the exciters, step-up transformers and separate compartments for station service transformers, rheostats, a storage battery for switch operation and an oil-tank installation. The building is of sufficient size to house three generating units and their auxiliary equipment. The pipe lines pass from the valve house under the operating-room floor to the wheels, and the steel-lined tailraces are located immedi-

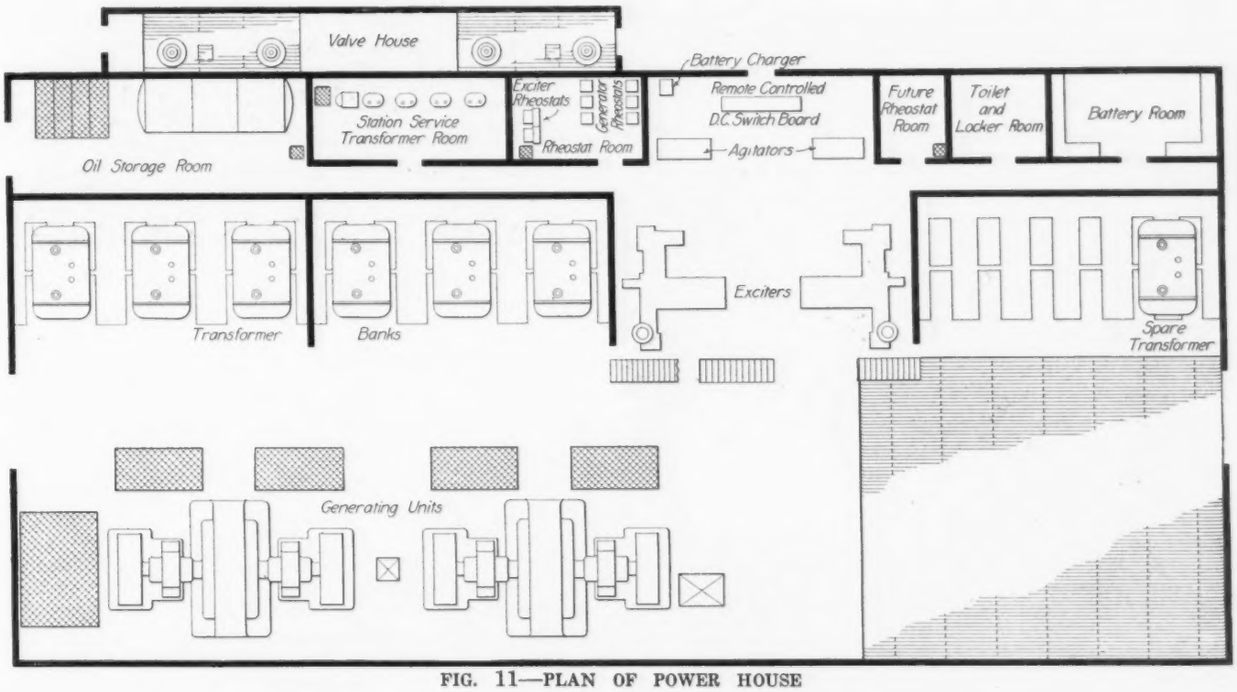


FIG. 11—PLAN OF POWER HOUSE

ately under each, opening directly into the river from the side of the building.

The main operating room is 168 ft. long by 43 ft. wide and is served from end to end by a 100-ton Cleveland electric traveling crane. The main switchboard, which is of the bench type, is located on a gallery in the center of the operating room, immediately above the

FIG. 12—150,000-VOLT OIL SWITCHES

exciter bay, and by remote control it governs the generators, transformers, switch operation and auxiliary control of governors and exciter motors. In the exciter bay, on the generator-room level, is a remote-controlled exciter and generator field board, to which are brought exciter and generator field leads. A small upright switchboard on the gallery takes care of the storage battery, lighting and local interior power service.

In case of trouble on any section of the apparatus,

FIG. 13—150,000-VOLT BUS STRUCTURE, POWER HOUSE NO. 1

an alarm system calls the operator's attention by both bell and lamp signals, a special trouble lamp being installed on the panel from which each piece of equipment is controlled. The upper portion of the station is given over almost entirely to oil-switch and bus installations. The step-up transformers are situated in bays on the generator-room floor level at the rear of the generating units. A railroad track extending into the generating room for about 30 ft. permits easy handling of them and of other heavy machinery during installation or repairs. The basement is laid out to give free access to the oiling system and other auxiliary equipment below the main floor. Water for cooling bearings, transformers, oil in suction tanks and other service is supplied by an independent piping system from tanks outside the station.

The second and concluding instalment of this article will include descriptions of Power House No. 2 and its 150,000-volt bus construction, operation of the transmission lines carried on nine-disk suspension-type insulators, provisions for switching at an intermediate substation, and the operation of the receiving substation, 9 miles from Los Angeles, where two 15,000-kva synchronous condensers are installed to neutralize the power-factor and voltage effects introduced by the capacity reactance of the long transmission lines.

Indicating the Decreasing Price of Electric Service

A spectacular and effective roof sign has been added to the number of these conspicuous advertising devices

SPECTACULAR SIGN INDICATING DECREASING PRICE OF ELECTRIC SERVICE

in use in Chicago. It has been placed by the Commonwealth Edison Company on top of the company's building at 28 North Market Street, and a shifting legend spells out the following message: "The increase in the amount of electric light $1 will now purchase as compared with 1896 and intervening years is shown by the height of these lamp outfits. Phone Randolph 1280." By the use of the "motograph" this message is run across the sign like some gigantic stock ticker in letters 6 ft. high. In the meantime the sign demonstrates the growth of the Commonwealth company's electric service, starting with the smallest lamp (which is visible in the accompanying picture entirely included in the base of the larger lamp) and changing step by step for succeeding years, indicating in large figures with each lamp outline, until the great tungsten lamp 50 ft. high stands forth in impressive outlines. While this is going on the torches on each side are flaring in a realistic manner and borders of light in different colors are running back and forth along the outlines. The sign was produced and built by the Federal Sign System (Electric), Chicago.

The Commonwealth Edison Testing Laboratories

Elaborate equipment provided and organization perfected for performing tests, "starting," supervising meters, making investigations, and affording technical consultations

WHILE the average electrical reader has heard a great deal about the large turbine units and other spectacular features of the plants of the Commonwealth Edison Company of Chicago, he probably knows little of the company's operating and maintenance work, although these departments embody features which are in their own way of no less interest.

In the *Electrical World* of Sept. 27, 1913, an account of the company's load-dispatching system was given, details of the routine of putting apparatus into service and cutting it out being included. Incidentally some of the duties of the "starting engineer" were mentioned. This official may, for the present purpose, therefore, serve as a connecting link between the dispatching and testing departments, for the starting engineer is attached to the latter's staff. As his title indicates, he has charge of starting up new or repaired equipment, a very important phase of the testing department's work.

The testing department is quartered in a large brick building, somewhat less than 140 ft. by 60 ft. in dimensions, situated at the rear of the North Market Street office building of the Edison company. One of its floors houses the laboratories and contains the offices of the chief testing engineer and his staff of fifty or more assistants. The plan of the floor is shown in an accompanying sketch. On the east side of the building, which is indicated at the top of the drawing, are the high-tension room (containing a 10-kw, 50,000-volt testing transformer and a 150-kw, 30,000-volt testing transformer) where insulators, insulating materials, etc., are tested; the meter and supply room, where a very large assortment of meters and other apparatus is kept in condition ready for instant use; the stock room for supplies of all kinds, and the photometer room.

The large general laboratory for general calibration, transformer, motor and other machine testing occupies a considerable part of the west side of the building. Partitioned off from this general laboratory but accessible to it are the oscillograph room, commercial calibration room and standardizing room. The chemical laboratory has ample quarters in the southwest corner. The remainder of the floor affords the office space for the staff, and is provided with conveniences for working up and filing reports.

The Laboratory Equipment

Before examining in detail a few of the more novel testing devices a general glance at the laboratory equip-

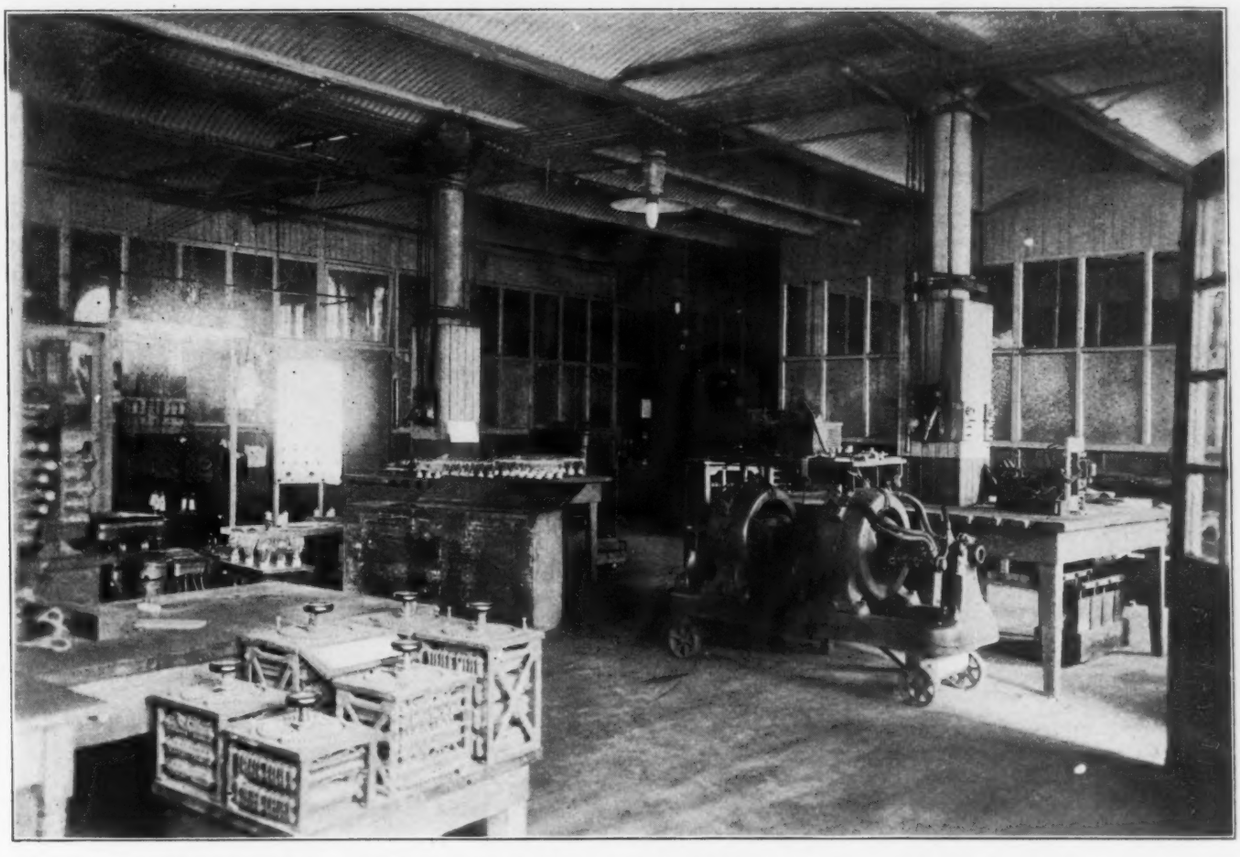


FIG. 1—GENERAL TESTING LABORATORY, COMMONWEALTH EDISON COMPANY, CHICAGO

ment may be of interest. Fig. 1 is a view in the general laboratory looking toward the oscillograph room and showing along with other equipment a portable motor-generator set for furnishing large currents at low voltages. Fig. 3 shows the oscillograph room, looking toward the meter and supply room. This oscillograph

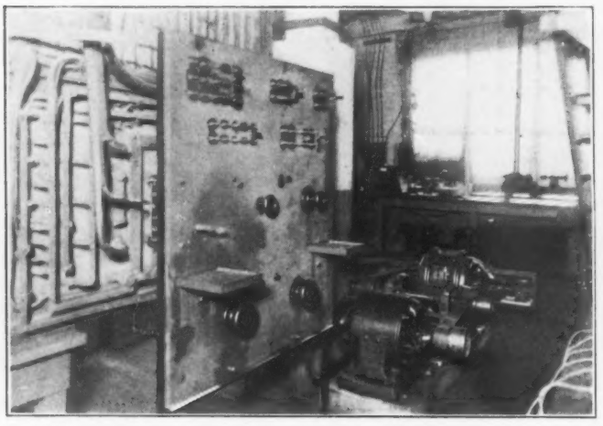


FIG. 2—VARIABLE-FREQUENCY TESTING SET

equipment is one of the most useful devices in the laboratory.

Fig. 7 shows a transformer-testing switchboard designed to reduce the time and labor required to make routine tests. Current and pressure leads are brought to the back of the board from the transformer room at the rear, permanent connections being made to the switch studs. The low-tension switches are mounted on the front of the board, while the high-tension switches are mounted on the back, being operated from the front by means of hard-rubber rods working in slots. The board is equipped with both alternating-current and direct-current incoming leads, the latter being used in making

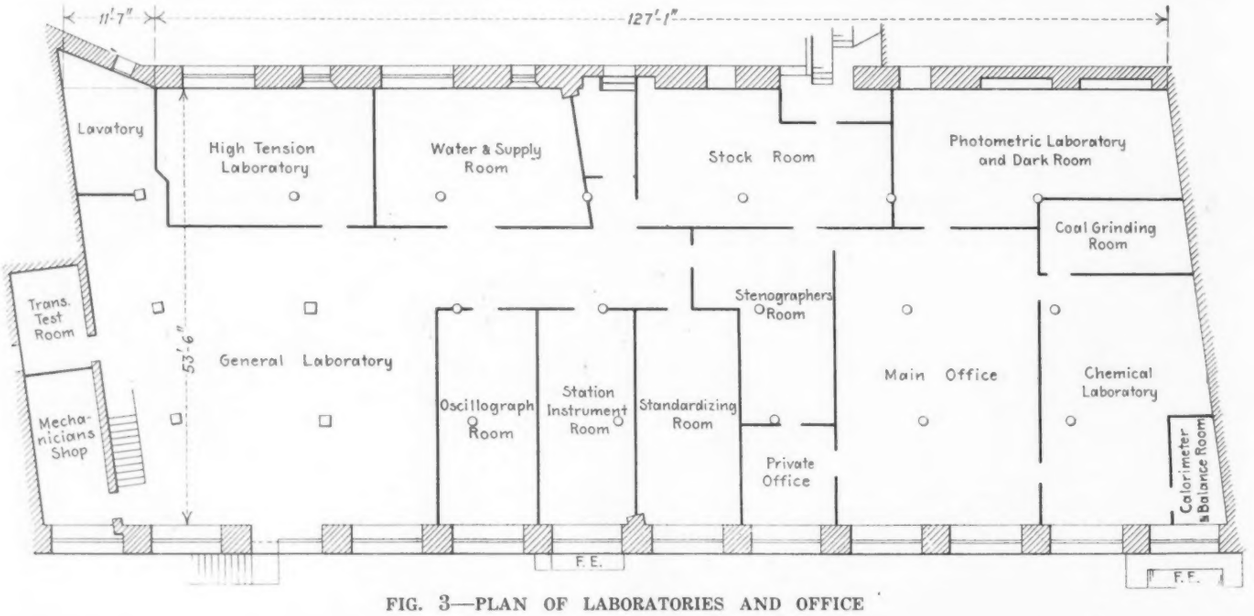


FIG. 3—PLAN OF LABORATORIES AND OFFICE

resistance measurements. Instrument studs are arranged at the bottom of the board, and studs at the top permit the ready insertion of resistance in the various circuits. Each pair of studs is otherwise short-circuited by means of a single-pole switch. With this board excitation, core-loss, no-load-ratio check, polarity check and load-back tests can be made. By a simple change in connections load-loss and impedance tests can also be made. The use of this board has greatly simplified the routine of transformer tests, of which a great many are made each month.

A variable-frequency, high-frequency motor-generator set with its switchboard are shown in Fig. 2. This

FIG. 4—HIGH-TENSION TESTING TRANSFORMER

unit furnishes current for the transformer tests. In Fig. 6 is shown a 10-kw, 50,000-volt testing transformer for use in making insulation tests.

Energy for alternating-current testing is furnished from three sources—the regular 60-cycle distribution system; a special connection to the 25-cycle supply for the Market Street substation, and a 40-kw generator provided with eight collector rings. By means of this arrangement two-phase, three-phase or six-phase current can be obtained. Instruments can also be tested at various power-factors by using one set of rings for current and others for voltage.

One corner of the general laboratory is occupied by the "heavy current" testing apparatus. This consists essentially of a set of heavy copper busbars through which direct or alternating current can be sent and to which apparatus to be tested can be clamped. There are two buses, each of two-ply, 0.5-in. by 4-in. copper bars, substantially mounted on an 8-ft. table. Heavy steel sliding clamps facilitate connection of instruments to

the bars. The direct-current supply is from a battery of two 5000-amp-hr. storage cells located under the housing. The terminals of the cells are brought out to a switchboard by means of which the cells can be used singly, in series or in parallel. Charging is done by means of the portable motor-generator set shown in Fig. 1, which can also be connected direct to the busbars.

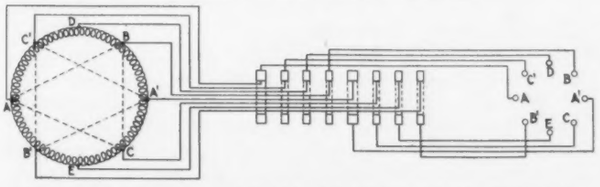


FIG. 5—CIRCUIT DIAGRAM OF EIGHT-RING TESTING GENERATOR

Direct current is measured by a 5000-amp water-cooled shunt seen on the floor at the right of Fig. 8. The current supply is controlled through three 2000-amp rheostats, one of which is adjustable.

On the alternating-current end of the testing table current is supplied at 25 cycles or 60 cycles from a company substation. It flows through an induction regulator to a 50-kw transformer having 220-volt and 110-volt primaries and 2200-volt and 1100-volt secondaries, and to a lowering transformer with 2000-volt and 1000-volt primaries and 20-volt and 10-volt secondaries. By means of a switchboard, containing four double-pole, double-throw switches, two front and two back, various combinations of connections can be made. The high-tension switches are mounted on a separate panel in the rear and are operated by hard-rubber rods. By means of the regulator and the transformers the busbar pressure can be varied from zero to 20 volts. The secondary winding of the transformer is connected directly to the busbars and has a current-carrying capacity of 5000 amp.

Development of the Testing Department

A résumé of the development of the present testing department will serve to explain in the most logical way its functions and responsibilities. It came into existence in 1898 under the then general inspector, Mr. F. R. Jenkins, as an adjunct to the inspection department. An Armour Institute instructor, Mr. T. P. Gaylord, was put in charge of this work, and Mr. Stephen Gardner was transferred from the drafting department to assist him. Transformer and lamp tests were then undertaken in a small room.

The engineering department gradually transferred motor testing, switchboard-instrument checking and miscellaneous work to the new department, and by March, 1899, some twenty-five pieces of apparatus had been secured for these purposes. This apparatus included a Weston laboratory standard voltmeter and a Weston standard ammeter with shunts, which were considered the pressure and current standards of the company.

During the summer of the same year new temporary quarters were occupied and provision was made for lamp sorting, photometering of exchanged lamps and testing practically all line transformers. Before the end of the year, after several changes in the personnel of the staff, Mr. G. N. Eastman was put in charge of the laboratory and Mr. R. F. Schuchardt, now electrical engineer of the company, was transferred from the statistical bureau, bringing with him the work of checking switchboard station instruments previously in service.

In the early nineties instrument checking had been done spasmodically by the engineering department, but in 1899 it was turned over to the statistical bureau as a matter for constant attention, and Mr. Schuchardt was assigned to it. For some time no attempt was made to correct meter inaccuracies; instead, stickers were pasted on the meter cases giving the errors found on checking. In extreme cases the instruments were returned to the makers for calibration.

In 1900 the laboratory was again moved, this time into larger quarters in the enlarged Edison building, and the cleaning and testing of returned lamps was handed over to another department to give more time for testing. The important tests then undertaken were on the "G. I." constant-current series arc-lamp system, on the grounding of four-wire three-phase circuits, on Nernst lamps, on 2000-volt inclosed fuses, and on the general transmission system of the company. The force was gradually enlarged for this work and included a mechanician.

Notable among the original ideas developed under Mr. Eastman between 1900 and 1902 were those resulting in a simplified instrument for making cable-fault locations by the Murray loop method; a compensating-coil arrangement for utilizing a length of copper cable or busbar as the shunt in the correct measurement of large direct currents by the Munich shunt method; the adaptation of Weston switchboard ammeters for use as reverse-current relays; a special design of electroscope for the indication of the pressure "high-tension" charge, and an insulating compound.

In 1902 Mr. E. O. Schweitzer, the present head of the testing department, was transferred from general inspection work and at first engaged in improving the quality of work done on the alternating-current switchboard instruments. The laboratory was again moved, this time to the basement of the Masonic Temple, and the stock of switchboard instruments was intrusted to its care. At this time the present system of buying all instruments with blank scales was inaugurated. This notable advance in meter practice gave very satisfactory results, because changes in station design between the times of ordering and installing meter equipment entailed no additional expense for calibration; emergency orders could be filled exactly in from two or four hours, and calibrations were more satisfactory than before,

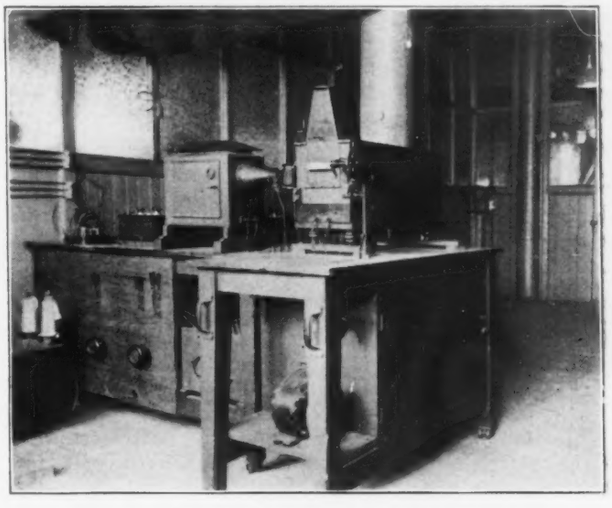


FIG. 6—OSCILLOGRAPH ROOM AND APPARATUS

as the instruments after calibration were not subjected to the jars incident to shipping. At this period also Mr. Eastman began tests upon small carbons for arc lamps which soon became important enough to be transferred to a small special laboratory.

As the laboratory grew, more and more work was taken over from the engineering department, including

the work of "indicating" steam engines in isolated plants, which was for some years thereafter shared with the contract department. In 1903 the "starting-engineer" system was definitely founded under instructions from Mr. L. A. Ferguson, vice-president, and the laboratory force was increased by several men whose duties included checking up connections and testing the

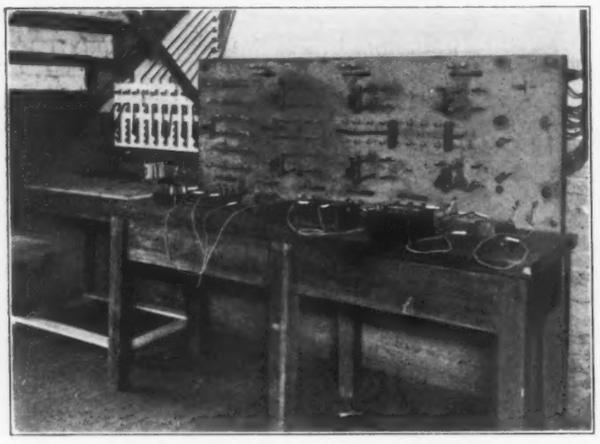


FIG. 7—SWITCHBOARD FOR ROUTINE TRANSFORMER TESTS

characteristics of new apparatus under the direction of the starting engineers. By 1905 the staff had grown in numbers to seventeen.

In 1905 new quarters were again assigned to the laboratory and the testing department was officially organized, replacing the "inspection department laboratory," as it had been called up to that time. As a tangible effect of the laboratory's work the first important publications began to appear at about this time, when Mr. Eastman read papers on the characteristics of inclosed-arc lamps and the use of small carbons before the Western Society of Engineers, and on protection and control in large high-tension alternating-current systems before the International Electrical Congress.

The work of the testing department now began to develop rapidly. Successful tests were made on the proper adjustment of frequency changers for parallel operation and the best methods of starting these units; the station-meter work was systematized, a plan of periodical checks was put into operation, and a complete card index of the metering apparatus connected to the system was prepared. The starting engineering work was gradually absorbed until deputies from the department came to be held responsible for the initial starting of all apparatus.

Coal testing and other chemical work was also taken on in 1905 and this, under Mr. C. H. McClure, gradually resulted in the present well-equipped chemical laboratory. This coal testing had been started by Mr. W. L. Abbott in 1897 in the engine room of Station No. 1 and the union of the chemical and the engineering testing work was, therefore, a logical step.

By 1907 the staff had grown to thirty-seven members, so that more room was needed and the laboratory began to expand into its present space, which was completed by the fall of 1908. In this period important testing, under Mr. N. J. Conrad, was going on at the Fisk Street Station, especially in the study of heat tests by means of a new type of exploring coil mounted in the large turbo-alternators. This study led to important changes in the design of the machines and to increases in their output. An investigation of surge phenomena in the 20,000-volt transmission system was also conducted and resulted in an A. I. E. E. paper by Messrs. Junkersfeld and Schweitzer. The meter test at this time also resulted in the invention of special attachments and improvements for watt-hour meters which have already had an important effect upon rates.

In 1909 Mr. Schweitzer became acting head of the testing department and Mr. W. A. Durgin was appointed his assistant. In the four years since then many important researches have been made and others are under way. The chemical department undertook the testing and renovation of transil oil until all oil required for the system is now regularly treated. Many new methods of testing were developed, the most important probably being the exploration method for the location of faults in underground cables described by Mr. Durgin at the 1910 N. E. L. A. convention.

In the early part of 1911 a test was run on a 12,000-kw unit in the Fisk Street Station to investigate the short-circuit characteristics of a turbo-alternator under various conditions with and without external reactance. This research provided material for two A. I. E. E. papers, one by Messrs. Schuchardt and Schweitzer on the use of power-limiting reactances with large turbo-alternators, and the other by Messrs. Durgin and Whitehead on the transient reactions of alternators.

Chief among other researches at this time was an extensive study of the heating of low-tension feeders, the results of which showed the feasibility of increasing their rating with an attendant saving in copper investment. As a result of the demand for a device to communicate continuously to a distance the value of a direct electrical measurement, a method for doing this was developed by Mr. O. J. Bliss and communicated by him to the A. I. E. E. in June, 1912. Among other inventions have been a lubricating brush for use on rotary converter collector rings, an oil-flow meter, and a graphite contact for contact-making voltmeters.

Present Organization and Work

As at present organized the testing department comprises the following sections: (1) testing engineering, (2) deputy starting engineering, (3) meter engineering, (4) operating engineering, (5) development of new devices and contributions to electrical knowledge, and (6) technical consultations. The duties of these several sections can be best seen by some illustration of what they do in every-day work.

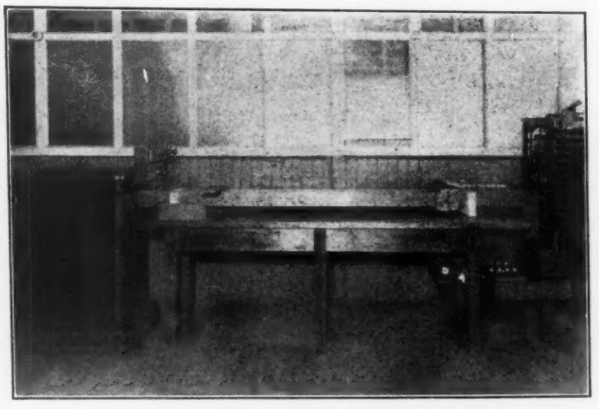


FIG. 8—BUSBARS CARRYING HEAVY CURRENT FOR TESTING PURPOSES

In the testing-engineering laboratory motors are tested for efficiency, rating and general operating excellence; heating apparatus is tested for consumption, efficiency and adaptation to the intended use; lamps, both incandescent and arc, are photometered and subjected to life tests, and new distribution transformers are investigated for efficiency, regulation and heating.

Distribution transformers injured in service are examined, the appropriate shop orders are issued for repairs, and the repaired transformers are again tested and sent out. During 1912, 274 preliminary and 396 final tests were thus made, the arrangement of testing apparatus already described making such large numbers of tests practicable.

Outside the laboratory, periodic heat tests on all large generating units are made to determine when the fields should be removed and the machines cleaned, this work having been rendered possible by the exploring coils contained in the armature windings. In the operation of the generators the accumulation of dirt in the ventilating ducts requires careful watching, an increase in heating as great as 100 per cent having been indicated by exploring-coil tests. Similarly transformers are regularly tested to determine when the cores have "aged" to a point where replacement is desirable.

In conjunction with the chemical laboratory tests are made on insulators, tape, galvanized material, lubricating oil, paint, rubber gloves, conduit, sleeves and lugs. To indicate the extent of this work it may be stated that in 1912 1530 insulators, 1300 pairs of rubber gloves, samples representing 5800 cable-junction sleeves and junction-box lugs, and 290 tanks of new insulating oil were tested. Fouled transformer oil was cleaned, dried and tested to the extent of 125 gal. per day. About forty samples of coal were tested per month in connection with its purchase on a heat-value basis.

In addition to routine tests such as those outlined special tests of the greatest variety have been made. Among those are the loss of coal in storage, the sanitary condition of drinking water, prospective customers' steam-plant load curves, causes of dissatisfaction with customers' motor equipments, reasons for unsatisfactory character of illumination or other applications of the company's service, cause of abnormal heating of new units in power plants (found to be due to "green" insulation and remedied by gradual increase of load for the first week or so), cause of heavy unbalancing of load on railway lines, and many others.

The deputy starting engineers, ten in number, have been kept very busy owing to the rapid increase in the

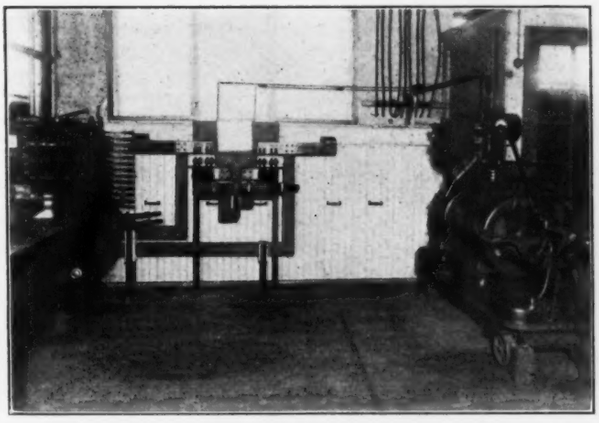


FIG. 9—HEAVY-CURRENT TESTING EQUIPMENT AND PORTABLE MOTOR-GENERATOR

capacity of the system. During 1912 they tested for the company two 20,000-kw generators, thirteen rotary converters from 2500 kw to 500 kw in rating, one 2000-kw frequency changer, nine very large transformers, two 8000-amp storage batteries, and three exciters and boosters. A number of large machines were also partly tested for railway customers.

In the meter work a stock of 1500 new and second-hand instruments is cared for in the laboratory and a record is kept of each of the 8000 meters, instrument transformers and relays owned by the company. All new meters are equipped with hand-drawn scales, and movements are readjusted and placed in accurate calibration, similar work being done on second-hand in-

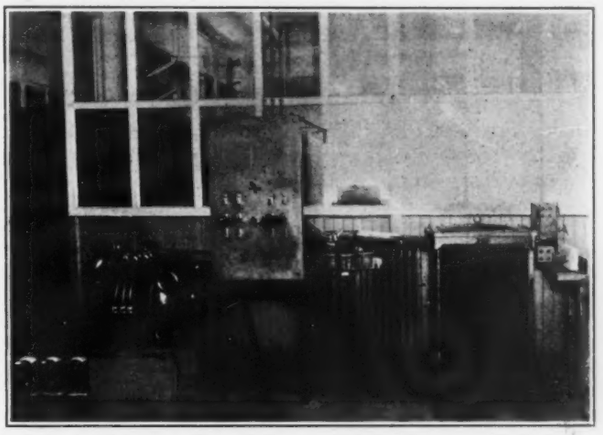


FIG. 10—VOLTAGE REGULATOR, TRANSFORMER AND SWITCHBOARD FOR HEAVY-CURRENT TESTING

struments. The output of these is about 100 per month. Some eighty instrument transformers are each month tested for insulation, continuity, polarity, etc., and about fifty relays are adjusted and set before installation. In the attempt to keep the meter practice up to date new devices are developed as required and new forms of meter and auxiliary apparatus are tested and investigated. Among recent original devices are the signal relays for the 60-cycle overload-relay operating bus and for the regulator limit switches. Original schemes of measurements proposed by the engineering department are checked for correctness of theory. The primary standards kept in the standardizing laboratory include Weston cells, potentiometers, a comparator, and an assortment of standard resistors and bridges, all of which are sent for frequent calibration to the National Bureau of Standards. Portable instruments are repaired by the standardizer.

The operating engineering work consists in continual tests for the engineering and operating departments to determine the condition of apparatus as to deterioration, reliability and efficiency. Along these lines tests on industrial transformers, generators, ventilating systems and split-pole rotaries have been recently completed. Occasional researches are also made to determine unknown hazardous conditions, and men are furnished to co-operate with the operating department in such emergencies as line breaks and system shutdowns. During the past two years stations and substations have been comparatively free from serious emergency troubles and the greater part of the work has been on fault location in cable break-down. The method mentioned earlier has been so useful that of forty-eight "locations" made in 1912 but one was a failure. Tests were made also to determine the best procedure for parallel operation of stations, many others to assist in adjusting feeders for proper circuit regulation, and others in adjusting relay settings throughout the distribution system.

The work of development has already been referred to, while that of consultation speaks for itself. Obviously the testing department engineers are in an excellent position to act in a consulting capacity to all other departments of the company and to its customers.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Getting Electrical Christmas Shoppers to Buy Early

During the holiday season just closed the Brooklyn Edison company sold nearly $10,000 worth of electrical appliances to local customers, practically tripling the sales records of the preceding year. Features of this Christmas campaign were the "early shopping" accomplished and the large sales made during the first weeks

CHRISTMAS DISPLAY IN THE BROOKLYN EDISON SHOP

of December—results attained by issuing invitations to 10,000 of the company's best residence customers to visit the electric shop for a special Christmas display held during the week of Dec. 8 to 13.

The year before practically no sales were made during the earlier days of December, thus resulting in a rush Christmas week which taxed the facilities and staff of the appliance sales department. Profiting from this example, the Brooklyn company this year issued 10,000 invitations for its advance exhibition of electrical gift things, which was set two weeks before the holidays proper. For the occasion the company's electric shop was ornamented with Christmas greens and with a huge electrically lighted Christmas tree, and electrically cooked refreshments were served to all comers. Meanwhile display advertisements were carried in the local papers emphasizing the idea of making the 1913 Christmas an electrical event in the household.

As the result of its "early shopping" encouragement, the company sold $350 worth of appliances daily during the week of the exhibit, while for the following week the daily sales rose to $550. On the Wednesday preceding Christmas, as was to be expected, the greatest business was done, nearly $1,500 being taken in. In general, these figures represented from three to four times the sales made during the preceding year, in addition to the advantage gained in getting the bulk of the business out of the way during the earlier weeks of December.

One of the features of the Christmas sales at Brooklyn was the large number of Christmas-tree lighting outfits disposed of. For several weeks the company carried newspaper advertisements emphasizing "the safety idea" in Christmas-tree lighting, and as a result of its campaign in this direction it disposed of about 500 miniature-lamp outfits. Most of these were of the eight-lamp size.

Methods of Handling the Cleveland Sales Organization

Thirty-three lighting solicitors besides motor-service and special salesmen are at present employed in securing new business for the Cleveland (Ohio) Electric Illuminating Company, and it has been said of these men that they are members of one of the best selling organizations in the country. Methods used in handling such an organization are interesting.

The entire force is divided into two sections according to the geographical location of each man's territory in the city. Each section is headed by a captain, who is himself a solicitor. As the dividing line of the sections separates the city into east and west halves, the two competing companies of solicitors thus constitute the "east" and "west" teams.

Fig. 2 shows how the records of the rival sections are kept from day to day. These four charts which hang

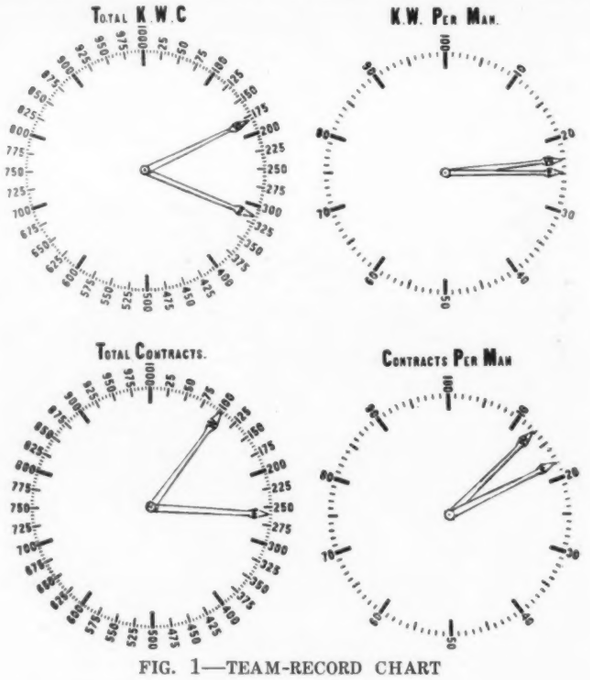


FIG. 1—TEAM-RECORD CHART

in the offices of the solicitors are reset every morning to read the total kilowatts connected, the total contracts, the kilowatts per man and the contracts per man. Letters "E" and "W" on the heads of the arrows tell which team is in the lead. In connection with these team-record charts two "high-man" diagrams are used. Opposite the names of each salesman are set two colored

buttons sliding on strings, their position indicating the total sales made by each man and the total kilowatts connected through his efforts. The card to the right marks the number of contracts secured and the number of gas installations displaced. A bonus system in force in connection with these charts awards the salesman a certain amount for each contract secured besides

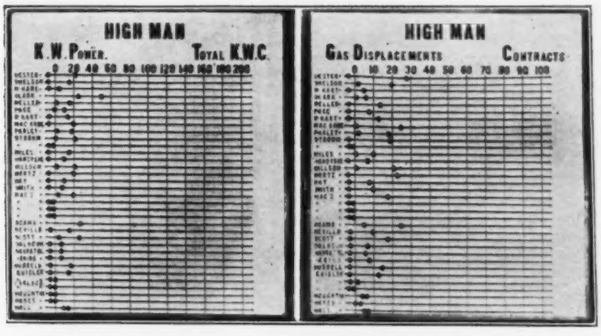


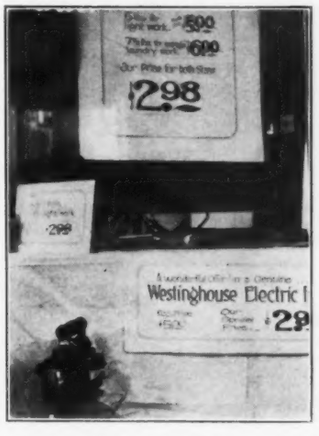
FIG. 2—"HIGH-MAN" RECORDS IN USE BY CLEVELAND SALES STAFF

netting him an additional $1 for each gas displacement. The bonus is paid monthly, deductions being made, however, for business discontinued within a year.

Reports of the solicitors are made as brief and as few as possible, for, says Mr. M. E. Turner, general contract agent for the company, the characteristics of a good salesman and a good clerk are very seldom found combined in one man, and what the company wants is salesmen. The men are therefore asked to put the maximum time on actual selling and to spend as little as necessary in telling of visits made in which no business was secured. Only reports of results are wanted. A check on absences from duty is furnished by daily time slips.

Featuring Electric Irons in a Boston Drug Store Show Window

An electric flatiron campaign was recently conducted in one of the Washington Street store windows of the Riker-Janes drug houses in Boston, a special mark-down price of $2.98 being made on irons of the 5-lb. and 7.5-lb. sizes. As shown by the accompanying photograph, the display was the main feature of the window, and it consisted of a 5-lb. iron mounted on an ironing board 30 in. long. This iron was moved back and forth by an arm carried through a central slot and oscillated by a crank and pulley installation driven by a 0.125-hp, 110-volt motor run on Edison service. The iron was operated at thirty reversals per minute and the display attracted sufficient attention, with the accompanying advertising signs, to enable the store to sell 100 irons in a week.



ELECRIC FLATIRON DISPLAY IN DRUG STORE

Advantages of Electric Vehicles in Municipal Truck Haulage

An elaborate report has been completed by the efficiency division of the Chicago Civil Service Commission in an effort to give the city scientific management in the cleaning of its streets and the collection of garbage and refuse. One portion of the report relates to the adaptability and economy of motor trucks for hauling refuse and the crushed stone used in repairing streets. For affording comparison of gasoline and electric trucks the accompanying tabular statement is presented.

GASOLINE TRUCK	ELECTRIC TRUCK
(a) Greater average speed possible.	(a) More efficient where short haul with many stops is encountered.
(b) Can be run continuously night and day.	(b) More efficient within its limits of operation, which approach from 50 to 60 miles per eight-hour day.
(c) Essential outside of the radius of operation of the electric truck.	(c) More economical motive power.
(d) Can do more work in a given time if speed restrictions do not interfere.	(d) Less average per cent maintenance and repair costs.
(e) To care properly for batteries requires the services of a man more difficult to obtain than in the case of gasoline motors.	(e) Less per cent depreciation.
(f) Less balking on unimproved streets.	(f) Requires less skill to drive.
	(g) Affected less in winter by temperature.

In making an estimate of the cost of hauling, the following assumptions as to cost of operation, interest and depreciation on investment have been taken into account:

Interest on investment.....4 per cent
Insurance and fire liability (gasoline), 3 per cent..$70 per annum
Insurance and fire liability (electric), 3 per cent...$63 per annum
Garage .....$25 per month
Compensation of driver (3-ton truck).....$80 per month
Depreciation on gasoline truck, estimated life 75,000 miles, on truck value, minus tires.
Depreciation on electric truck, estimated life 100,000 miles, on truck value, minus tires.
Tires—Depreciation based on guarantee, 8000 miles.
Contingencies—Covering interest on general operating stores, repair materials, general superintendence, etc., 2 per cent of the first cost.
"Antiquasion"—Estimated as a fixed charge, it being a factor which decreases the value of equipment owing to improved methods in the science of construction, 5 per cent.
License—State license paid by the city, $4 per year for 3-ton truck.

OPERATING VALUES

Taken from actual results obtained in the operation of 14 standard gasoline trucks, 100 electric trucks and data obtained from the Massachusetts Institute of Technology, Experimental Work.

Size of Truck	No. of Miles per Gal. for Gasoline Cars	No. of Kw-hr. per Mile for Electric Cars
2-ton	5.00	0.741
3-ton	3.92	0.903
4-ton	3.20	1.064
5-ton	2.70	1.225

Assuming that a 3-ton truck is loaded to full capacity, an estimate was made of the cost per mile of hauling refuse as compared with the present cost of hauling by two-horse garbage wagons, which are now hired by the city at $5.50 a day. The results of these analyses are shown in Fig. 1. It will be noted that the cost of operating the electric truck is cheaper than that of the gasoline truck for all lengths of haulage and is cheaper than the $5.50 per day horse-drawn vehicle for hauls

over 2 miles in length and the $6 per day horse-drawn vehicle for hauls over 1 mile in length.

Tests have been made during the year on the use of motor trucks for hauling crushed stone and material for street-repair work. The conditions of such work are generally favorable, as the time required to load and unload is relatively small, the travel of the truck is confined almost entirely to streets, and the maximum length of haul is within the province of electric trucks.

Curves showing miles per day, cost per ton-mile and cost per ton delivered for different lengths of haul in street-repair work on horse-drawn, gasoline and electric trucks are given in Fig. 2. These curves show that the use of motor trucks is more economical than that of the horse-drawn vehicles when they are used for a period of at least 300 days a year. If the period in which the transportation equipment is used is less than 180 days each year, which is the minimum period in which street-repair work will be made during any year, the use of the horse-drawn asphalt wagon is more economical, while the use of horse-drawn crushed-stone wagons is less economical than any type of motor truck. The curves further show that in order that the cost of using

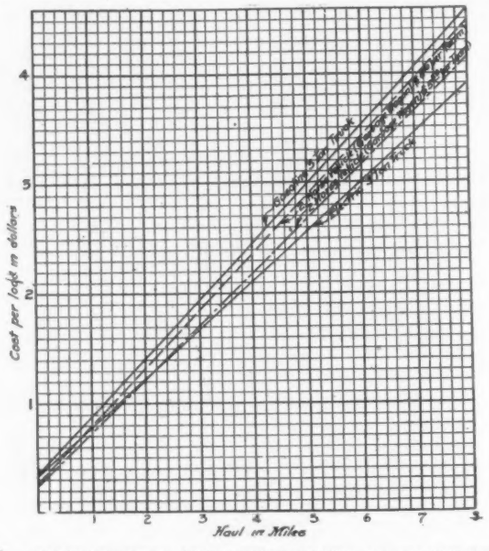


FIG. 1—COMPARATIVE OPERATING COSTS OF HORSE-DRAWN WAGONS AND MOTOR TRUCKS IN HAULING GARBAGE

electric trucks instead of asphalt wagons shall be equalized the electric truck must operate at least 230 days a year and the gasoline truck must operate at least 260 days each year. Under favorable conditions the motor trucks will be more economical than horse-drawn vehicles for the transportation of crushed stone and asphalt, and the use of electric trucks will show a probable saving of about 25 per cent.

Among the conclusions reached as the result of the division's study of the economy and adaptability of motor trucks for hauling garbage and other city refuse are the following:

1. That at the prevailing cost of team hire the saving by the use of electric trucks for hauling garbage in such wards as have a considerable haul would amount to 5.1 per cent of the cost of removing such garbage by teams.

2. That if the cost of teams were increased to $6 per day the total estimated saving by using motor trucks for hauling would be about $15,775 per year, or 12.3 per cent of the estimated cost of teams at $6 per day.

3. That, inasmuch as these estimates are computed on the eight-hour-day basis, and as the present working period of garbage teams rarely amounts to eight hours per day, the working period being often as low as six hours, the saving would exceed the percentage given.

4. That the more economical power truck has been found to be the electric one. This is governed in a measure by the low rate of cost of electrical energy from the Sanitary District to the city for off-peak energy, and by the fact that the collected data on the electric truck have shown lower per cent rates for de-

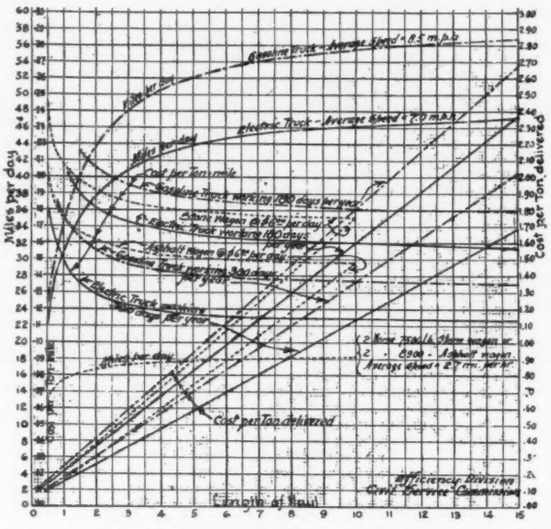


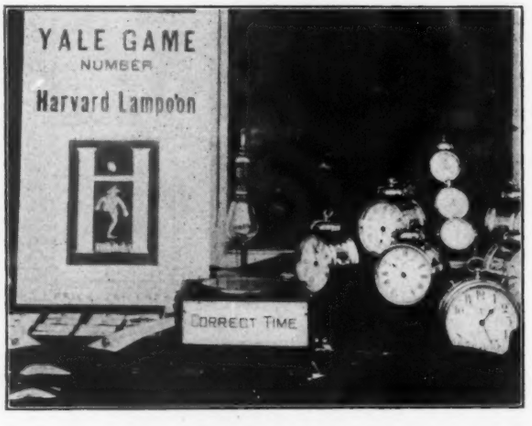
FIG. 2—COMPARATIVE OPERATING COSTS OF HAULAGE IN STREET-REPAIR WORK

preciation, maintenance, repair and insurance than those for the gasoline truck.

5. That the haul below which an electric truck carrying 3 tons would not be economical when measured against a team at $5.50 per day is found to be about 1.8 miles and when measured against a team at $6 per day is 0.8 mile.

Long-Hour Burner in Jeweler's Window

The lighting of sidewalk clocks provides an excellent long-hour use of central-station service, this class of business being desirable even on the small scale illustrated in the accompanying halftone. A Cambridge



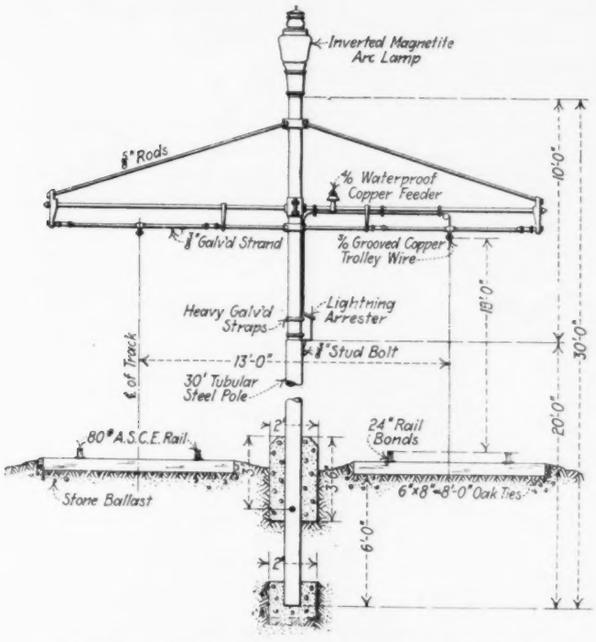
ELECTRIC LAMP ILLUMINATING CLOCK DIAL ALL NIGHT

(Mass.) jeweler whose shop is much frequented by college students burns an all-night 25-watt lamp just above his window chronometer. At the ordinary 10-cent rate the lamp yields the local central station about $7.50 per year, and the jeweler finds the advertising value of the expenditure well worth while.

Illumination and Wiring

Combination Trolley and Lighting Poles in Cleveland Suburb

Shaker Heights Village, a residential suburb of Cleveland, Ohio, now being improved by a real-estate development company, has been equipped with a street-lighting system in which General Electric inverted-type magnetite-arc lamps are mounted at the tops of the trolley poles in the center of the street. The lamps



COMBINED TROLLEY-WIRE SUPPORT AND LAMP POST

are placed on alternate poles, making them approximately 200 ft. apart. The thoroughfare being lighted in this way is a 120-ft. boulevard and the arc lamps are raised about 25 ft. above the roadway. Energy is supplied through underground circuits.

As an economical measure the method of concreting the bases of the poles on this job is worthy of notice. To give the pole stability 1.5 ft. of concrete was placed at the base. Then, after filling the hole with about 2.5 ft. of earth, the concreting was resumed to a point 12 in. above the surface of the ground. In this way the pole attains stability and is protected from the action of the earth and moisture at the top of the ground where most rusting occurs.

The design and construction work on this line were done by the Cleveland (Ohio) Construction Company.

Signal Lamps Bring Prolix Speakers to Time

The transactions of a professional convention held recently in New York City were speeded up considerably with the aid of a system of electric signal lamps which served to warn prolix speakers before they exceeded their time limits. At the beginning of the session it was announced that to each member taking part in the discussion would be allowed five minutes in which to express his views. Mounted on the platform in plain view of both the speaker and his audience was a pair of incandescent lamps, one colored red, the other green. At the end of the fourth minute the green "cautionary" signal was lighted, thereby giving the speaker warning that he must close his remarks in the next sixty seconds. Then at the end of the five minutes the red lamp flashed its danger signal, unmistakably "flagging" the train of oratory and clearing the way for the next speaker.

Cost of Installing Luminous-Arc Ornamental System

Since early summer, a "white-way" system has been in operation at Green Bay, Wis., consisting of twenty-four General Electric 4-amp luminous-arc lamps. This ornamental lighting system extends over a distance of two 750-ft. city blocks, or a total of 1500 ft. Posts are installed on both curbs at intervals of 60 ft., being placed opposite each other. At the cross street lamps are placed on each corner. Plans are now being made to install sixty more of these luminous-arc units, extending the present white-way system over five other blocks in the business district.

The present twenty-four lamps are supplied with energy from a seventy-five-lamp rectifier, being connected into the same circuit with the forty-eight lamps of the local series magnetite street-lighting system. For the installation of this ornamental lighting system complete, ready to turn on, the cost was as follows:

1500 ft. No. 6 steel-taped cable	$333.30
Ornamental posts	492.00
High-tension cut-out switch for post	96.00
24 4-amp luminous-arc lamps	840.00
Cementing posts and bolting to curb	158.00
Chiseling trench, laying cable in curb, and all necessary labor, including tunneling streets	540.00
	$2,459.30

For the twenty-four posts installed the cost complete has averaged approximately $103 per post. The items above entered were taken from bills and are accurate. While the item of labor is a little high, this heavy construction cost is accounted for by the necessity of tunneling from curb to curb beneath an asphalt-paved street at two different points. In order to lay the cable it was also necessary to chisel between the concrete curb and the sidewalk throughout the entire 1500-ft. distance. This cable is laid at a depth of 4 in. and is covered with concrete. The method of installing the posts consisted simply in chiseling out, for a depth of 1 in., some of the concrete in the sidewalk to the size of the base of the post. The bolts were then anchored in place, and concrete was poured in the space, the posts being erected while the concrete was fresh. The resulting construction gives the post a solid foundation, besides making a workmanlike job in mounting the base flush with the sidewalk. The cable runs were made before the posts were installed, enough cable being left at each position to make the required connection to the cut-out switch in the base of the post. Access is gained to this switch by means of a hinged door placed in the base.

The cost of installing Green Bay's ornamental lighting system is being paid for on a monthly-payment plan by the White Way Lighting Club, an organization of merchants along the street benefited. The company agreed to install the system for $2,400, the merchants to repay this outlay in three years at the rate of $66.67 per month. In addition to these instalments on the erection cost, the operating charge runs $80 per month, based on a net rate of 5.9 cents per kw-hr. The lamps are burned daily from dusk to midnight, which is equivalent to 2000 hours per year. As each lamp consumes about 300 watts, the company figures its own

income at $40 per year per lamp, including maintenance, breakage, glassware, etc. Following are the figures for the cost of operating and maintaining the system, which agree closely with the preliminary estimates furnished by the manufacturers:

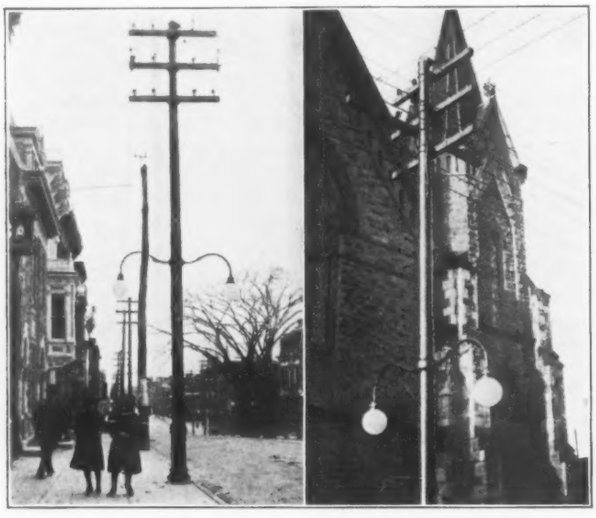
Energy for 300-watt lamp, 2000 hours per year, at 5.9 cents per kw-hr	$35.40
Trimming and labor per lamp per annum	2.00
Electrodes per lamp per annum	1.40
Repairs per lamp per annum, covering five years' test	0.20
Rectifier tubes per lamp per annum	0.33
Average glassware renewals per lamp per annum	0.69
Total cost of energy consumed and maintenance per lamp per annum	$40.02

As an alternative to the luminous-arc system an installation of tungsten ornamental lighting was first proposed for Green Bay, using five-lamp posts, each carrying five 100-watt lamps. At an operating cost of $6 per post the expense for twenty-four posts would have been $144 per month, or $1,728 per year. For a five-year period the cost would total $8,948. In such a tungsten lighting system, however, approximately forty posts would have been required to take the place of the present twenty-four-post luminous-arc system. With the latter posts, costing $3.34 per month to operate, the yearly expense is but $960, making the expense for five years $4,800.

Combination Lighting Posts at Hudson, N. Y.

The incandescent street-lighting system just completed at Hudson, N. Y., to replace an installation of inclosed-arc lamps has several novel features well adapted for use in cities of this class as evidenced by the approval of the local public.

On the principal business streets ornamental iron poles are used, each carrying two 60-cp lamps. The posts are spaced at an average distance of 110 ft. on each side of the street, with poles opposite except at



COMBINATION LIGHTING POSTS AT HUDSON, N. Y.

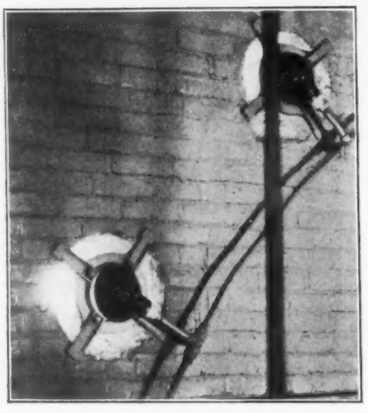
street intersections, where a diagonal layout is adopted. Each of the 860 lamps used is inclosed in a 13-in. opal globe.

The new poles carry the line wires, trolley spans and transformers formerly supported on wooden poles. The lamps are fed from a series circuit, the wires entering the top of the iron pole through a special two-piece terminal provided with porcelain tubes. The wires are brought down inside of the pole and out at the lamp through one hole into a hollow ornamental casting. This casting is clamped around the pole and supports the bracket arms besides furnishing means for concealing the wires. On less important streets the existing wooden poles are retained, being equipped with extra heavy brackets for supporting the lamps. In the parks, for summer use only, forty-five three-lamp iron poles fed from underground conduit are to be installed.

The contract for this ornamental street lighting was awarded to the Albany Southern Railroad, the details and installation having been looked after by Mr. R. P. Leavitt, who was formerly the electrical superintendent of that company.

Springfield (Mass.) Clock-Tower Lighting

A notable feature of the recently completed municipal group of buildings on Court Square, Springfield, Mass., is the illumination of the great clock which has been installed in the campanile tower at a height of over 200 ft. above the street. Each of the four sides of the tower is provided with a clock face about 14 ft.



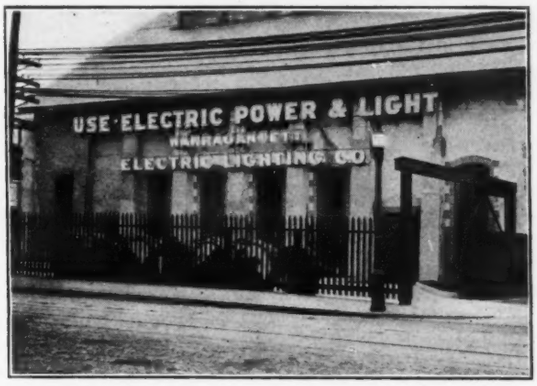
METHOD OF ILLUMINATING FIGURES ON CLOCK DIAL

in diameter, and at each numeral, from 1 to 12, inclusive, a conical-shaped opening has been left in the brickwork. On the inside of the tower, as illustrated in the accompanying illustration, 7-in. aluminum-finish Holophane steel reflectors are set at the center of each numeral opening, being lined up by a metal ring secured to the wall by ribbed lugs. Inside each reflector is a 60-watt tungsten lamp wired from a circular conduit as shown, the total connected load of the clock numerals being 2.88 kw.

The clock hands are rotated about a center equipped with five 40-watt lamps set behind a ground glass. The minute hands, 10 ft. long, are each lighted by five pairs of "linolite" lamps rated at 50 watts each, or 500 watts per hand; and the hour hands, 7 ft. long, are marked with three pairs of "linolite" lamps of the same size. The connected load resulting from the lighting of the clock centers and the hand outlines is 3.2 kw, making a total load of about 6 kw for the clock dials complete. On the top of the tower, 300 ft. above the street, is a ball equipped with thirty-two 150-watt lamps arranged to flash the hours and quarters in red and white bulbs, the flasher being operated by the Betts & Betts main clock mechanism in the tower. Energy for this service is supplied by the United Electric Light Company, and the wiring installation was made by the M. B. Foster Electric Company, of Boston, Mass.

Advertising on the Storehouse

Although its principal storehouse is somewhat off the paths of retail business, the Narragansett Electric Lighting Company, of Providence, R. I., is a stanch believer in the gospel of electric-sign advertising. To turn the storehouse wall into a "business getter," the company has installed the sign shown in the accompanying halftone, and the results by day and by night have justified the trouble. The sign is 65 ft. long and 9 ft. high, and its letters contain about 500 10-watt, 110-volt lamps, the individual letters being 18 in., 24 in.



ADVERTISING ON STOREHOUSE, PROVIDENCE, R. I.

and 30 in. high. The use of these different sizes helps to attract attention by daylight, and few passers-by go through the street without looking at the wall of a building otherwise of a type common in New England mill construction. Although the wording of the sign is

TABLE SHOWING NUMBER OF LAMPS IN SIGN LETTERS

18-IN. LETTERS														
Letter	N	A	R	G	S	E	T							
Number of lamps	11	8	11	9	10	9	7							
24-IN. LETTERS														
Letter	E	L	C	T	R	I	G	H	N	O				
Number of lamps	9	6	8	7	11	4	10	9	11	8	1			
30-IN. LETTERS														
Letter	U	S	E	L	C	T	R	I	P	O	W	&	G	H
No. of lamps	11	11	13	8	10	8	13	5	12	12	17	20	12	12

usual, the proportions are more than ordinarily effective. The accompanying schedule of the number of lamps per letter furnishes convenient data.

Recent Telephone Patents

The selective system patented by Mr. R. F. Spamer, of New York City, and assigned to the Western Electric Company, is designed for use with railway dispatch systems. The novelty consists in controlling the application of the step-by-step signaling impulses by the simultaneous operation of an impulse-producing relay with a line relay. When the step-by-step mechanism operates it causes the desired line relay and the impulse-producing relay to operate synchronously, applying energy from the battery to the desired line. By the use of this method the lines are left free from any step impulse mechanism, except during selection.

Another patent assigned to the same company for a dispatch system has been granted to Mr. E. R. Gill, of Yonkers. N. Y. The particular feature in this system lies in arranging the circuits so that each tower man may signal others as required but yet the circuit be under control of the message man when he requires it. Indicators show visibly the condition of the line.

Most receiver-supporting arms are adapted to hold a receiver permanently, but in the one invented by Mr. A. Wetzel, of Los Angeles, Cal., the receiver clamp consists of a receptacle from which the receiver may be readily transferred to the hood switch when not in use. The supporting arm consists of the usual links and clamps for holding the receiver against the ear of the user.

There has been patented by Mr. W. O. Beck, of Ridgefield, N. J., and assigned to the Western Electric Company, a special arrangement of shelf support for steel wall telephones, the object being to provide a shelf support which may be mounted with a minimum amount of extra labor. The shelf support, therefore, takes the form of an auxiliary backboard of sheet steel with flanged edge. Two lugs project from the top flange, which are adapted to hoop into slots in the bottom flange of the bell box. The holes near the base of the shelf-supporting backboard register with the lower mounting holes of the regular backboard.

With multi-party lines there is frequent interference, owing to the listening in of non-wanted stations. This causes not only interference but waste of battery energy. Mr. A. R. Nelson, of Janesville, Cal., has endeavored to overcome this by arranging an interlocking device between the hook switch and the generator crank. The result is that the transmitter battery circuit is not closed upon the rising of the hook switch until after the line has been found idle and the generator crank has been turned.

Letters to the Editors

Daylight and Artificial Light

To the Editors of the Electrical World:

SIRS:—The editorial on "Daylight and Artificial Light" in your issue of Nov. 29, page 1091, raises a number of interesting questions on a subject which, as you say, should be further investigated. Without, by any means, assuming to answer definitely all of the questions propounded, I think some of the most important ones are explained by facts within our present knowledge.

Artificial light may differ from daylight, as received through windows, in any one of the following respects: (1) color, (2) direction, (3) area of source (generally called diffusion), and (4) quantity.

As to color, we may doubt whether there is any marked difference in the comfortable character of daylight and artificial light due to this cause, for, as stated in your editorial, a wide variation daily takes place in the color of daylight without any noticeable change in its comfortable and satisfactory qualities.

When we come to direction, however, there is usually a very important difference. Daylight is usually received through windows at one side or the other of the work. In other words, we have a large light-giving surface, the sky, casting light on the work at a decidedly oblique angle in the case of ordinary desk work or reading.

With artificial lighting by the methods ordinarily employed, we may have any one of the following conditions: A source of light of high intrinsic brilliancy or surface brightness (and therefore of small area) may be placed close to the work. Or smaller light sources may be placed at various positions above the worker, casting light upon the work. Under any such conditions there will be positions where specular reflection from various surfaces will be annoying on account of the small size and great surface brightness of the light-giving source.

If, on the other hand, an indirect system of lighting is employed, the light-giving surface is mainly a large patch of ceiling located above the work. While conditions will be greatly improved by increasing the size and reducing the surface brightness of the source of light in this way, the disadvantage of its position above the work is still somewhat apparent in the specular reflection or glare from horizontal surfaces, such as polished desk and table tops and papers lying on desks. Glare of this kind is frequently not recognized by the ordinary observer, but is nevertheless very apparent to the expert and may be the cause of considerable eye strain.

The area of the light-giving source with daylight is fairly comparable with the area in an indirect artificial lighting system, but there is, of course, a large difference between daylight and artificial lighting from small high-brilliancy sources commonly known as direct lighting. It is the area of the source which determines what is usually called diffusion of the light. If the source is large, such as the sky visible from a window or a ceiling, we usually call the light "diffuse."

An indirect-lighting system, so planned that most of the light is received from comparatively small areas of the ceiling above each fixture, is one which is likely to produce much less comfortable illumination than an installation in which the light is spread almost evenly over the ceiling. This is because the bright spots on the ceiling tend to produce uncomfortable specular reflection from polished surfaces.

In my opinion, it would have a most unfortunate effect on current practice in illumination design were the idea to get abroad that when putting in an indirect-lighting system the effort should be made to give more definite direction to the light than is now the case in the majority of installations of this kind. Indeed, I feel very strongly that the effort should be in the other direction.

To put the matter in another way, if we are to imitate daylight more closely we must have greater uniformity in the brightness of the light-giving surfaces, since approximate uniformity usually characterizes the sky within the range of a window.

As to quality of daylight, there are, as your editorial points out, immense differences between different parts of the same room, and also, it might have been added, from moment to moment at the same spot in a room. We must remember that daylight values of illumination are usually much higher than the minimum which may be comfortably used for working purposes, whereas artificial lighting intensities are for economical reasons held down near the lowest values at which work can be comfortably done. This fact alone is responsible for some of the faults found with artificial light as compared with daylight and to some extent may answer the puzzling question as to why a given degree of artificial lighting is sometimes less satisfactory about dusk, when it is first used, than it becomes later in the evening. Probably the facts are in many cases that the artificial lighting provided is barely sufficient for comfortable work and is, besides, miserably arranged, so that it is not until the user has fully forgotten the better daylight conditions and has become fully accustomed to the less satisfactory artificial lighting that he can get along without protest.

Although it is a common saying that a mixture of daylight and artificial light is bad and that the change from daylight to artificial illumination should be made at once by pulling down the shades and depending on artificial light altogether, I have seen so many cases where this tradition could be disregarded with comfort that I am inclined to put it in the same class with the exploded theory that "night air is dangerous." Doubtless there is some foundation for both traditions in certain observed facts. But I have yet to see a case where the mixture of daylight and artificial light was less satisfactory than the artificial light alone, unless the artificial light required a change in the user's position which was disregarded. I am not prepared to say that such cases do not exist, but as a general rule when there is complaint about the combination of daylight and artificial light it is high time to begin an inquiry into the defects of the artificial lighting. If the artificial lighting has defects that begin to be apparent even before the assistance of daylight is withdrawn, they are very likely to continue to make trouble after dark.

A careful study of this question of diffusion during the last few years has convinced the writer that, leaving aside the question of quantity, the superiority of good daylight over artificial light for most reading and work lies in its direction combined with the large sky area of the source and the minimizing influence which such direction and area have upon the glare of specular reflection from surfaces on which one may be doing close work. The phenomenon tersely summed up as "glare from paper" is responsible for an immense amount of eye fatigue and discomfort, due in part to the paper employed and in part to the direction and diffusion of the illumination on the paper.

Between conditions of glare from paper or other polished surfaces which are so bad that they cannot be tolerated and conditions of absolute comfort and freedom from such glare there exists a wide middle ground where glare, although present in so small a degree as to be generally unnoticed, is nevertheless enough to produce considerable eye strain. Such insidious conditions may therefore cause much more damage than would glare in a degree so pronounced as to force the reader to seek a change of position to avoid it.

With daylight illumination through windows, the angle from which the light comes, together with the large light-giving sky surface available, causes the greatest possible freedom from the pernicious effect described.

Chicago, Ill. J. R. CRAVATH.

Central Stations and Public Good Will

To the Editors of the Electrical World:

SIRS:—As the result of experience in contracting for house wiring and the installation of apparatus and the sale of gas and electrical appliances, I feel that from the standpoint of good will public utilities would be considerably ahead in the long run if they confined themselves to the sale of gas and electricity and left all contracting and sale of appliances to the local contractors and dealers. It would be necessary, of course, to supervise the work of the contractors and dealers and to assist them, to the end that the consumers should receive proper treatment and that the sale of gas and electricity be properly encouraged.

On account of the growth of the municipal and government ownership idea and the appointment of state public service commissions, it would seem very important that the public utilities remove from themselves such parts of their organization as are not directly related to the manufacture and sale of energy and as may be the cause of dissatisfaction and complaint. I should be pleased to see a discussion started in your columns that will bring out an expression of opinion from public utilities over the country.

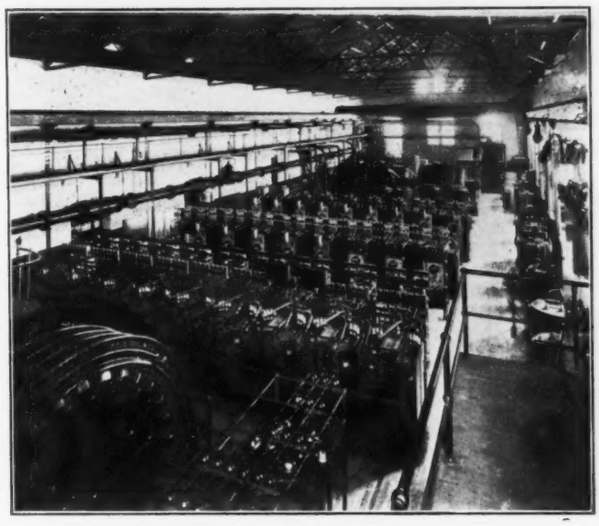
New York. R. D. WILLIAMS.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

A 12,434-Hour Rectifier-Tube Record

Few electric-lighting plants have regularly obtained such long lives from rectifier tubes as does the Public Lighting Commission of Detroit. Mich. From records kept for this municipal system, it was found that one tube operated satisfactorily for 12,434 hours and 30 minutes, although it had been guaranteed for only 500



DETROIT MUNICIPAL PLANT ENGINE ROOM, SHOWING MERCURY-ARC RECTIFIERS

hours. Another, guaranteed for the same life, lasted 10,047 hours and 55 minutes. Seven tubes had a life of more than 100,000 hours, and eight lasted over 8000 hours. The average life of tubes used at this plant is 2939 hours and 16 minutes. This record includes tubes in use up to Nov. 1, 1913, those which have been allowed to rest and then had renewed life, and those which have been discarded.

This remarkable tenure of life for rectifier tubes is attributed to the careful attention and treatment which they receive at the Detroit plant. Each tube when in use is immersed in an oil bath which is kept at a constant temperature of 80 deg. Fahr. by coils through which water circulates. The attendants have become so skilled in adjusting the flow of cooling water that the temperature remains practically constant. The temperature of each bath is observed and water adjusted every fifteen minutes.

The tubes are equipped with automatic shakers which restore the arc in case a tube drops its circuit, but these shakers are never allowed to continue rocking the bulb without the cause being investigated. Generally the tube is found to be in need of a rest, and if this is the case it is replaced by a fresh tube and itself treated to renew its usefulness. The method which has seemed to give the best results is to wash the tube in warm soapsuds, next thoroughly drying it, and then baking it in an oven. The washing is declared to remove deposits from the inside of the glass, and the baking anneals the glass and relieves static strains. The tubes are then allowed to rest for a length of time, after which they are found in condition to give satisfactory service again in most cases.

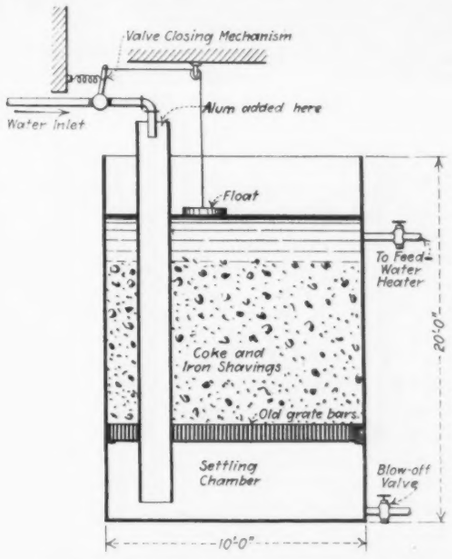
Weaknesses in rectifier tubes are generally denoted by their dropping their circuits. When the lamps on the circuit are the cause of this phenomenon it is considered good practice to equip the tubes with static dischargers. Then when the circuit is dropped the resulting surge of current and rise in voltage is taken care of by the discharger.

Mr. Frank R. Mistersky is general superintendent of the Detroit public lighting system. Thirty-one seventy-five-lamp rectifiers are in use at the main station and ten or more are installed in the substations.

Home-Made Water Purifier

In the upper Ohio valley the fact that steel mills and other industrial plants empty their refuse into the rivers renders the already impure water practically unfit for use in steam boilers. Accordingly, Mr. E. B. Sever, superintendent of motive power for the East Liverpool (Ohio) Traction & Light Company, devised the accompanying scheme for ridding make-up water of most of its impurities.

An old condenser mounted in a pit has been remodeled to act as a purifier. Water enters at the top and, flowing through a leading-in pipe, is conducted to the bottom of the chamber. Grate bars discarded from the boiler room have been arranged to form a shelf in the tank at a distance of about 3 ft. from the bottom. On this shelf are supported coke and iron and steel turnings from the car shops of the company.



WATER PURIFIER IN CONDENSER PIT

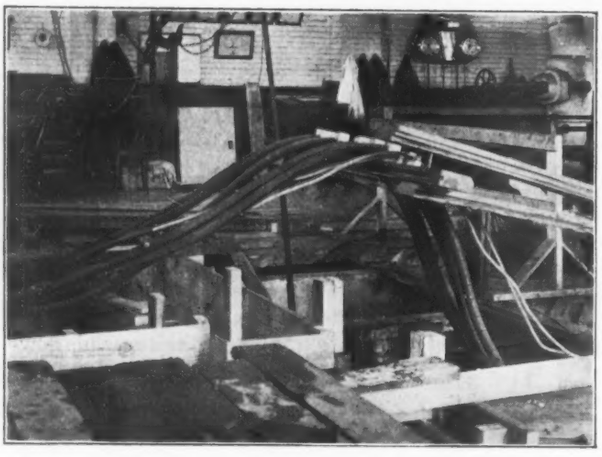
About 1 lb. of alum is introduced at the leading-in

pipe eacn hour, while a plentiful supply of lime is kept in the purifier at all times. When the device was first installed lime in liberal quantities was put in the boilers themselves as the water in the river contains considerable acid. For removing all solid matter from the water the spongy mass formed by the alum is found to work well with the 10-ft. coke and iron filter, which has been tamped into the tank to form a fairly compact mass.

A float acting against a spring automatically controls the opening and closing of the inlet valve, keeping the water supply at an almost constant level.

Handling Heavy Cables While Plant Is Rebuilt

In the construction of an industrial power plant it became necessary to relocate the switchboard and to install a turbo-generator on foundations directly in front of the original location of the panels. Pending the movement of the board to its new site the concrete foundation had to be built for the new generating unit, but difficulties were encountered in doing this on account of the presence of pairs of 2,000,000-circ. mil

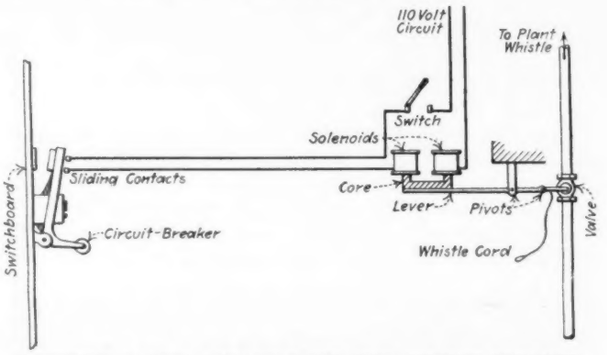


HANDLING 2,000,000-CIRC. MIL CABLES DURING PLANT RECONSTRUCTION

cables running through the space assigned to the new foundation. In order to enable the forms for the foundation to be placed in position a base panel was cut out of the switchboard and the cables were raised to the position shown in the photograph. Here they were clamped temporarily by porcelain insulators screwed into cross-pieces of 3-in. x 6-in. timber. In turn these cross-pieces were fastened at their ends to similar timbers braced at points near the front and bolted to the floor at the rear. In this way the slack of the heavy cables, aggregating 4,000,000 circ. mils per leg, was cared for and the foundation was poured without delay to either the existing service or the subsequent setting up of the generating unit.

Whistle-Alarm Attachment for Circuit-Breaker

Although in nearly every modern station some sort of circuit-breaker alarm is used, the idea of employing the plant whistle as a telltale to inform the operators that an overload has tripped a breaker is rather unusual. The diagram shown herewith illustrates how this principle has been applied in the Steubenville (Ohio) plant of the Tri-State Railway & Electric Company. Metal parts of the breaker in the open position complete the 110-volt circuit, which includes an electromagnet. When the latter is energized from this 110-volt source, its movable poles are pulled upward. This action transmitted through the lever to the whistle valve allows steam to escape and blow the plant whistle.



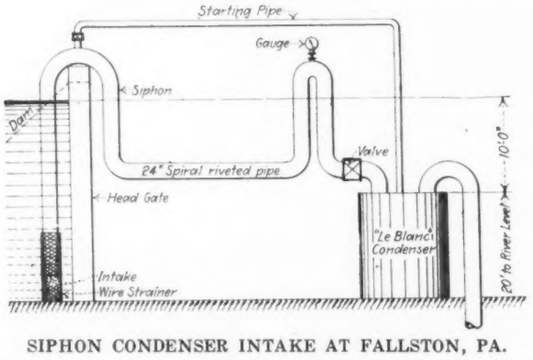
WHISTLE-ALARM ATTACHMENT FOR CIRCUIT-BREAKER

The fact that the whistle makes such a loud noise is said to be a large factor in accelerating the movements of the men who are supposed to restore the circuit to operation. As the whistle can be heard at the office of the chief engineer, it also affords an easy check on the interval of time elapsing between the moment at which the breaker opened and the time it was closed.

Siphon Condenser Intake

Tunneling under a dam or headgate for a condensing-water intake is no small piece of work, and the expense involved may be quite large. A less costly and yet altogether satisfactory solution of this problem has been worked out, however, at the plant of the Fallston (Pa.) Beaver County Light Company. When the installation of an extra condenser unit became necessary a large siphon constructed of 24-in. spiral riveted pipe was placed over the headgate at one extremity of the dam. A pipe line of the same size was continued to the Leblanc condensers.

With all lines connected, the problem of starting the water over the bend in the siphon was met by running a small pipe from the top of the bend shown in the illus-



SIPHON CONDENSER INTAKE AT FALLSTON, PA.

tration back to the condenser. The condenser pumps then being started created a partial vacuum in the 24-in. pipe, causing water from the river to be forced into the siphon. When the pipe line was filled the valve near the condenser was opened, allowing a continuous flow into the condenser.

Experiments with the starting pipe showed that if

the small pipe was left open while the condenser pumps were in operation much better results were obtained, and when measurements were made it was found that the vacuum which it was necessary for the pump to maintain had been reduced by about 4 in. or 5 in. The explanation will be apparent from the sketch, since the siphon is using the effective head on the condenser and is assisted by the action of the condenser pumps on the small pipe which is removing all air from the pocket that would otherwise be formed at the top of the bend in the siphon. The pipe at the right of the condenser shows a proposed outlet which will give a 20-ft. fall to the river.

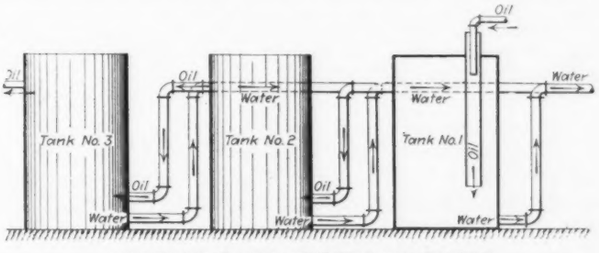
Cleaning Iron and Steel by Electricity

A method recorded for cleaning oil and grease from the surface of sheet-iron or steel stampings or sheets, preparatory to galvanizing or plating the latter, is worthy of note. An electrolyte is prepared consisting of a pound of caustic potash and two ounces of potassium cyanide to each gallon of water. The metal to be cleaned is immersed in this solution and an electric current passed through it. A pressure of 6 volts to 10 volts is required and a power of about 250 watts per square foot of surface to be cleaned. The current is kept on for a period of five to ten minutes, when a film of bluish-white metal is seen on the cathode. The polarity is then reversed and in a few minutes the metal is found to be clean and bright. This process is said to be cheaper and more effective than hand cleaning.

Multiple-Tank Gravity-System Oil Filter

An inexpensive oil filter in the station of the East Liverpool (Ohio) Traction & Light Company, embodying the ideas of the chief engineer for the company, Mr. J. S. Murphy, has been giving excellent results during the past year. As shown in the accompanying drawing, the apparatus consists of three tanks mounted in the same horizontal plane. Oil entering at the top of tank No. 1 is conducted down to a point near the bottom. Here the action of gravity impels the oil to rise while the tendency of the water is to remain below. As will be seen, the pipes which carry off the waste water and the separated oil are at the same level, so that when the tank becomes full water and oil will flow from the two outlets simultaneously.

Some water is still retained by the oil after it has passed the first tank, but as the process is repeated in tanks No. 2 and No. 3 the percentage of moisture and



MULTIPLE-TANK GRAVITY OIL FILTER

other impurities remaining is reduced to a value which is practically negligible when the oil is used as an engine lubricant. All pipes carrying waste water are connected at the same level as are those which conduct the oil from one tank to the other. This home-made oil filter, it is estimated, has saved fifteen barrels of oil since it was placed in operation less than a year ago.

Single-Phase to Three-Phase Transformation

In a step-down transformer system connected star to delta, if a transformer is open-circuited on the high-tension star side, thereby leaving only two transformers in circuit on one side, will the delta connection still give three currents displaced in phase by 120 deg. on the low-tension side? Apparently there are only two transformers across one phase on the high-tension side, which would have to transform from single-phase to three-phase. If this can be done, I should like to know how the displacement of 120 deg. between phases is obtained. J. J. B.

When one main lead of a three-phase system is opened the other two operate as though they were the two leads of a single-phase system. Such a system cannot deliver three-phase energy, whether the transformers are connected in delta or in star. When three transformers are delta-connected one of the transformers (but not the connections to one main lead) may be removed without changing the system from three-phase to single-phase. Moreover, a system may continue to operate as though polyphase when receiving energy from a single-phase source, if the energy is utilized to drive machinery which in itself converts from single-phase to polyphase. For this purpose stationary transformers are unsuited; energy storing—that is revolving—machinery is required. Electric locomotives for the Norfolk & Western Railroad electrification will utilize revolving machinery for converting the received single-phase energy into polyphase energy for the propelling motors. The scheme employed was described in our issue dated Aug. 23, 1913.

Transformer-Generator Unit

We have a new 100-kw, 60-cycle, three-phase generator, wound for 2300 volts, and also an older 50-kw, single-phase machine of the same frequency, but wound for 1150 volts. We want to use the large machine for the night peak load and the small one for the day load and the off-peak load. What will be the loss by stepping up the emf with a transformer from 1150 volts to 2300 volts? We do not desire to go to the expense of scrapping the old generator, which is in good condition but cannot be changed to 2300 volts, and buying a new generator of the same size, while a second-hand generator of that size will cost as much or more than a transformer. If the transformer loss is only 2 per cent or 3 per cent, we believe the transformer method to be the cheapest under the circumstances. We have a 50-hp engine for the small generator and a 150-hp engine for the larger one, but think it cheaper to use the small outfit for off-peak load rather than run the larger engine half loaded. W. D. C.

Your plan for operating your 1150-volt, 50-kw generator at 2300 volts is entirely feasible. A well-designed two-coil, 50-kw transformer, to step up the voltage from 1150 to 2300, would have a copper loss of about 11 watts per kilowatt and an iron loss of about 6 watts per kilowatt, the total loss therefore being about 800 watts. The loss would therefore be about 1.6 per cent. An even more advantageous plan would be to employ a so-called auto-transformer, which is connected as though it consisted of one coil operated to deliver 2300 volts but tapped so as to permit energy to be fed into it at 1150 volts. For this purpose there could be purchased a one-to-one ratio 25-kw transformer, each coil being designed for 1150 volts and the two coils being connected in series for delivering 2300 volts. This transformer would probably have a copper loss of about 12 watts per kilowatt and an iron loss of about 6 watts per kilowatt, the total loss, therefore, being 450 watts. When operated in this way the loss would be somewhat less than 1 per cent. Therefore, instead of purchasing a 50-kw transformer having a loss of 1.6 per cent, you could purchase a 25-kw transformer having a loss of only 0.9 per cent. This transformer could well be connected permanently to the generator and the two could be operated as a unit just as though the generator were built for 2300 volts.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

International Standardization of Electrical Machinery.—A. R. Everest.—A paper read at Birmingham giving a review of the work of the International Electrical Commission on standardization of electrical machinery. The rules so far adopted are based on considerations of the highest safe temperatures for various insulating materials, the joint effect of time and temperature, and also the probable difference between observable temperature and maximum internal temperature. From these considerations an international agreement was reached regarding the permissible limits of temperature for various insulating materials employed in modern electrical machinery. In connection with these permissible temperature limits, rules have been provided regarding the proper determination of the temperature of the cooling air, a knowledge of which is necessary to ascertain the temperature rise, which must not be exceeded at the rated load of the machine. Finally, rules are provided dealing with the differences which may exist between the temperature rise on test and under service conditions due to variations in the cooling temperature and the barometric conditions. Following are the limits of observable temperature adopted by the commission for different insulating materials:

	Deg. C.
Non-impregnated cotton	80
Impregnated cotton or paper (general)	90
Impregnated cotton, single-layer field coils, stationary or moving	95
Impregnated cotton, stationary coils, solidly impregnated throughout	95
Impregnated cotton, rotor and stator windings having the slot portion solidly impregnatel or molded	95
Enameled wire (without cotton)	105
Mica, micanite, asbestos (general)	115
Mica, micanite, single-layer field coils, stationary or moving	120
Mica, micanite, stationary coils, solidly impregnated or molded	120
Windings permanently short-circuited:	
Insulated	100
Non-insulated	110
Commutators, slip-rings	90
Bare rings	80

Permissible limits of temperature are useless to the designer except in conjunction with information regarding the cooling temperature, since the difference between these two values is the "temperature rise" which the machine may create when carrying its rated load. The I. E. C. rules now require that the maximum and not the average temperature of the cooling air shall be stated, but agreement has not been reached regarding an international standard-reference air temperature. Although the I. E. C. recommends that "wherever possible the temperature of the cooling air should be stated and the machine constructed for this cooling condition," it is also proposed to establish a value which shall be taken as the maximum temperature of the cooling air when no specific information is available. At Berlin a majority of the delegates, including those from Great Britain and the United States, desired to set this reference temperature at 40 deg. C., while a minority desired 35 deg. C.—London *Electrician*, Dec. 12, 1913.

Single-Phase Mercury-Vapor Rectifier.—J. Epstein.—An account of the experience obtained in practice with a 240-volt, 360-amp mercury rectifier which has been in use in a German foundry since December, 1911. The apparatus is reliable and has converted so far 275,000 kw-hr. The rectifier supplies energy to motors without a storage battery. Details are given of the efficiency obtained, with an analysis of the different losses.—*Elek. Zeit.*, Dec. 11, 1913.

Commutator as Frequency Changer.—H. Meyer-Delius.—The first of a series of articles on polyphase commutator motors. In the present instalment the author discusses the commutator as a frequency changer. Two quarter-phase machines, identical in all respects save that one is provided with a commutator and the other with slip-rings, are taken for illustration. It is first assumed that the rotors are blocked and the stators excited from a polyphase line of constant potential and frequency, the voltage and frequency across the brushes on the commutator and across the slip-rings being noted. The rotors are then allowed to revolve at half synchronous speed and the voltage and frequency are again investigated. Direct current is next impressed on the revolving rotors and the resulting action discussed, a slightly different commutator machine being assumed in this case. Other conditions of excitation are considered and the involved phenomena are pointed out in each case.—*Gen. Elec. Review*, December, 1913.

Transformer Designs.—M. Vidmaer.—A long mathematical paper in which the author gives the outline of a simple theory for dimensioning the cross-section of the yoke of a transformer and for selecting the sheet iron employed in its construction so as to make the cost a minimum.—*Elek. u. Masch.* (Vienna), Nov. 30, 1913.

Lamps and Lighting

Lamp Output in Germany.—F. Fasolt.—The first part of a review of the statistics prepared in connection with the German lamp tax. The number of carbon incandescent lamps made in 1910 was 26,000,000; in 1911, 25,000,000, and in 1912, 21,000,000. The number of metallic-filament lamps made in 1910 was 42,000,000; in 1911, 47,000,000, and in 1912, 76,000,000. The number of Nernst lamps made in 1910 was 249,000; in 1911, 131,000, and in 1912, 78,000. The weight of arc-lamp electrodes formed of pure carbon averaged 8,000,000 kg during each of the last three years, and that of impregnated carbon electrodes averaged 2,600,000 kg per year.—*Elek. Zeit.*, Dec. 11, 1913.

Radiation from Carbon Lamps.—Lummer.—An abstract of a paper read before the German Illuminating Engineering Society on the determination of the law of total radiation from carbon incandescent lamps by means of the observed true temperature of the carbon filament. One of the important conclusions of the paper is that the carbon filament radiates as a "gray body." A "gray" body is one that radiates always less than a "black" body, but for each wave-length the percentage difference between the two radiations is the same, besides being the same for all temperatures.—*Elek. Zeit.*, Dec. 11, 1913.

Gas-Filled Incandescent Lamps.—A note on a recent British patent (No. 27,432, 1912) of the British Thomson-Houston Company and the Allgemeine Elektricitäts

Gesellschaft of Germany. A quantity of gas at very low pressure is kept constant throughout the life of the lamp by previously impregnating a porous body with the gas-producing material and inserting this in the lamp. For example, a very small tube of silicic acid and an organic binder are boiled in chloride of copper and then dried and drawn into wire, which is mounted in the lamp.—London *Elec. Eng'ing*, Dec. 11, 1913.

Vacuum-Tight Seal for Lamps.—A note on a recent British patent (No. 18,300, 1912) of the British Thomson-Houston Company and the General Electric Company of this country. A low-expansion glass is mixed with progressively larger quantities of silica to make a series of melts. The glass is finely powdered and ground quartz is added. The different glasses resulting are used successively from the quartz tube until a glass having the same expansion as tungsten is available. A tungsten or molybdenum leading-in wire fused into this makes a vacuum-tight seal.—London *Elec. Eng'ing*, Dec. 11, 1913.

Effect of Ultra-Violet Rays on the Human Eye.—An abstract of a paper by Schanz read before the German Illuminating Society in which the author recommends that lamp rays of short wave-lengths be absorbed, as can be done by means of euphos glass. The necessity of doing so was questioned in a discussion. Voege claimed that a special protective glass for ultra-violet rays was unnecessary. Lamps should be so suspended that direct glare is avoided. Indirect or semi-indirect illumination is particularly recommended.—*Elek. Zeit.*, Dec. 11, 1913.

Fluorescent Light.—W. S. ANDREWS.—An address on radio-luminescence. After describing the production of fluorescent light by certain substances, a number of the common elements are named whose compounds possess this light-giving property. It is then shown that such compounds, the light from each of which possesses an intrinsic predominating color, can be made to produce light of a useful color, in a few cases closely approaching daylight. The substance is placed in a tube with a gas furnishing a complementary color and is subjected to the influence of an electric discharge. The remainder of the paper is given over to a description of a number of experiments concerning the properties of the light emitted by various fluorescent and phosphorescent substances.—*Gen. Elec. Review*, December, 1913.

Generation, Transmission and Distribution

Two-Phase-Three-Phase Transformation. — H. DE PISTOYE.—After having discussed in a former article the Scott system in which a two-phase magnetic circuit is used, the author now describes the Leblanc system employing a three-phase magnetic circuit. While the Leblanc system seems to be theoretically superior in most cases, yet its advantage is so very slight that in practice both systems must be considered as equivalent. Under certain conditions, however, one or the other system may be preferable. For instance, for a two-phase distribution system operating at very low voltage in an electrochemical plant the Scott system is advantageous, while in a three-phase distribution system of the same character the Leblanc system is preferable.—*La Lumière Elec.*, Dec. 6, 1913.

Electric Drills.—An illustrated article on recent improvements in electric drills.—*Mitt. Siemens & Halske*, November, 1913.

Powdered Coal.—G. A. ROUSH.—An illustrated description of a new powdered-coal burner of W. R. Dunn. —*Metall. and Chem. Eng'ing*, January, 1914.

Traction

Single-Phase Traction and Telephone Lines.—G. GIROUSSE.—The conclusion of his illustrated article in which simple means are discussed for overcoming the disturbing effects of single-phase lines on telephone lines in the neighborhood.—*La Lumière Elec.*, Dec. 6, 1913.

Electric Railways.—The conclusion of the illustrated article on the electrical equipment on railways. This instalment deals with automatic circuit-breakers, brakes, couplings between cars, etc.—*Mitt. Siemens & Halske*, October, 1913.

Railway Electric Signaling.—H. M. JACOBS.—There are now in general use three systems of railway signaling, viz., mechanical, electro-pneumatic and all-electric. Except for a brief explanation of the principles of the mechanical and electro-pneumatic systems, this article is concerned only with the all-electric. On steam roads direct current for signaling is mostly employed, both rails being insulated from block to block and made to serve as conductors. On direct-current roads only one rail is sectionalized in some cases, and where the voltage drop due to the propulsion current is troublesome, special polarized relays are used. On still other direct-current roads alternating current is used for signal purposes, with operating relays that are unaffected by direct current. The most recent practice employs both rails for propulsion-current and alternating-current signal purposes, the rails being sectionalized at block ends and connected by impedance bonds which offer negligible resistance to the propulsion current but sufficient impedance to the signal current.—*Gen. Elec. Review*, December, 1913.

Installations, Systems and Appliances

Electricity Supply in Large Cities.—G. KLINGENBERG. —A long abstract of a paper read before the (British) Institution of Electrical Engineers. After giving a short account of the methods at present employed in London, Berlin and Chicago for the generation and distribution of electrical energy, a discussion of the factors determining the cost of energy supplied to consumers is undertaken. Consideration of the operating conditions in the London, Berlin and Chicago plants permits figures of comparative costs to be deduced, and these apparently indicate that the most economical arrangement is to employ a few large stations. The application of this idea to the conditions now prevailing in London is discussed, and some figures for the cost of conversion of the present arrangements to a scheme of this kind are given. The various factors which have an effect on the results are also enumerated. In the discussion which followed Messrs. Snell, Ferranti, Tapper and others discussed the London situation.—London *Electrician*, Dec. 13, 1913.

Resistance Divisions for Series-Motor Operation.— E. R. CARICHOFF.—An article, illustrated by diagrams, presenting a graphical method to simplify the apportioning of the amounts of resistance that should be connected to the points of a series-motor controller to insure the motor's best operation. A description of the method of laying out the diagrams is given, along with a mathematical proof of their correctness. The usual superiority of graphical methods over arithmetical ones is brought out in connection with the application of series-parallel operation.—*Gen. Elec. Review*, December, 1913.

Extinguishing the Arc on Breaking a Contact.—W. BURSTYN.—A long translation in abstract of his recent German paper, which has already been abstracted in the Digest, on a new method of extinguishing arcs and its applications to switches and interrupters.—London *Electrician*, Dec. 12, 1913.

Wires, Wiring and Conduits

Electric Valves as Protective Apparatus.—G. GILES. —An illustrated article the object of which is to refute

an experiment recently published by Gierlich. This experiment had been thought to show the inefficiency of the Giles electric valve as a protective apparatus, but the present author claims that the experiment was faulty because the apparatus was not properly adjusted.—*Elek. Zeit.*, Dec. 11, 1913.

Electrophysics and Magnetism

Gamma Rays.—E. Rutherford and H. Richardson.—The authors have analyzed the gamma radiations emitted by the radium products radium B, radium C, radium D and radium E into a number of groups of different penetrating powers. They have now also examined the thorium products—viz., mesothorium 2, thorium B, thorium C and thorium D—and the actinium products by a similar method and have obtained results of the same general character as in the case of radium. The gamma rays of these substances consist of distinct groups of rays absorbed exponentially by aluminum and differing widely in their absorption by matter.—*Philos. Mag.*, December, 1913.

Electrochemistry and Batteries

High-Temperature Laboratory Furnace.—E. F. Nothrup.—An illustrated description of a new high-temperature electric laboratory furnace using artificial graphite as the heating element. This furnace permits a particularly exact temperature control.—*Metall. and Chem. Eng'ing*, January, 1914.

Electrostatic Concentration.—H. C. Parmelee.—An illustrated article on the concentration of complex sulphide ores from the Mary Murphy mine in Colorado. The problem is a rather complicated one, and the system includes electrostatic separation of zinc-iron middlings for the production of zinc concentrates.—*Metall. and Chem. Eng'ing*, January, 1914.

Ozonators.—A. Vosmaer.—A concise illustrated description of various different ozonator designs both with and without solid dielectrics between the electrodes. The systems of Schneller, Tesla, Otto, Vosmaer, Siemens, Gerard and Vohr are described and illustrated.—*Metall. and Chem. Eng'ing*, January, 1914.

Units, Measurements and Instruments

Torque Meter.—H. H. Broughton.—The author describes three methods of measuring the angle of twist of a torque-meter spring and gives detailed particulars of a spring torque meter of simple and inexpensive construction. An account of a number of interesting tests is included. With one exception the instruments used in the author's laboratory are of the spring type on account of the torque—5-lb.-in. units to 1000-lb.-in. units—being too small to give a sufficiently large angle of twist to a straight strip of spring steel. In the instrument in which a 30-in. length of 0.5-in. square steel

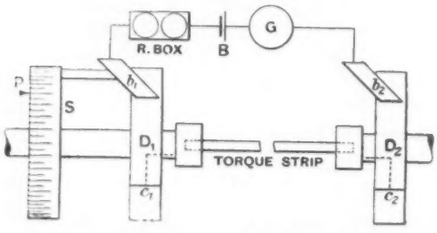


FIG. 1—ELECTRICAL METHOD OF DETERMINING THE ANGLE OF TWIST

is twisted the maximum torque to be measured is 5000 lb.-in. units, and the speed of 50 r.p.m. makes it imperative to use an electrical method of measuring the angle of twist. The arrangement is shown in Fig. 1. The brush b_3 can be moved till the narrow metal contacts c_1 and c_2 in the disks D_1 and D_2 make contact simultaneously with the brushes b_1 and b_2, thus completing the circuit and causing G to deflect. The angle through which b_3 has been rotated is recorded by the pointer P on the scale S. In the electro-optical method a disk provided with a pointer is fixed to the driving shaft, and a second disk, graduated on the rim, is secured to the driven shaft in such a position that the pointer overlaps the scale. A spark-gap connected to the secondary

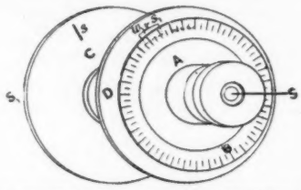


FIG. 2—DIRECT METHOD OF DETERMINING THE ANGLE OF TWIST

terminals of an induction coil is suitably mounted in the neighborhood of the scale, and the primary circuit of the coil is interrupted for a brief period each revolution by a break in the continuity of a contact disk mounted on the shaft (the break is exactly in line with the pointer). During this period the spark which bridges the gap illuminates the scale, and a continuous stationary image is impressed on the eye. Compared with the optical method, however, both the arrangements described above are crude. In this method the angle is determined by means of the arrangement shown in Fig. 2. To one shaft S is secured a disk A which carries a ring-shaped celluloid scale B, and to the other shaft S_1 two disks C and D are fixed, one of which, C, has a narrow radial slit s and the other a window w and a radial slit S_1, in line with the slit s in C. The width of the window is about equal to 15 deg. of arc. On illuminating the scale from the back an observer looking through s sees a broad arc of the celluloid scale and at the same time a bright streak due to the slits s_1, which serves as an index and eliminates parallel errors. With the apparatus in motion the three disks are at rest relatively to one another as long as the torque is constant, and it is evident that a clear view of part of the scale will be obtained. At all speeds above 300 r.p.m. the observer sees a stationary scale and pointer, and the angle of twist can be read with ease. A slight variation of torque, such as the application of a finger to the shaft, causes the scale to take up a new position with respect to the pointer. Details are given of the construction of a torque meter and the results of tests made with it.—London *Electrician*, Dec. 12, 1913.

Magnetic Tests of Sheet Iron.—F. Goltze.—The author has applied the Zickler method for determining the hysteresis and eddy-current losses in sheet iron from the latter's maximum permeability and elastic resistivity, and finds errors of about 10 per cent as compared with the wattmeter method. He therefore prefers the latter method for practical tests. Zickler in his reply agrees with the author concerning this conclusion, but points out that his object was not to supplant the wattmeter method.—*Elek. u. Masch.* (Vienna), Dec. 7, 1913.

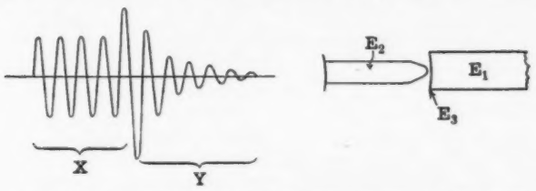
Testing of Alternators.—In a continuation of the long illustrated serial on shop-testing of electrical apparatus, the discussion of tests of alternating-current generators and synchronous motors is continued. The present instalment deals with the determination of efficiency from losses, temperature tests, methods of loading, compromise load, phasing-out of alternating-current generators and synchronous motors, special tests, and the drying of alternating-current generators and motors.—*Elec. Jour.*, Dec. 11, 1913.

Capacity Measurements.—K. Haubner.—The author

gives a simple derivation of the approximate formula which is usually employed in connection with Maxwell's bridge method for capacity measurement.—*Elek. u. Masch.* (Vienna), Dec. 7, 1913.

Telegraphy, Telephony and Signals

Wireless Telegraphy.—The first part of an illustrated article on Dubilier's wireless telegraph and telephone



FIGS. 3 AND 4—CHARACTER OF OSCILLATION AND DETAIL OF FIXED AND MOVABLE ELECTRODE

apparatus. A high-frequency generator is first described by which trains of waves are set up having a tendency to be particularly undamped for a certain period, and then damped or quenched for a further period; that is to say, a combination of waves is produced in each train as shown in Fig. 3. In all the apparatus heretofore designed for producing undamped oscillations, except the rotary high-frequency generator, the discharge takes place between electrodes stationary or movable, but in order to produce powerful oscillations the discharge is strained either by an air blast, by cooling, by rotation or by a magnet. To produce undamped oscillations of a constant amplitude it is necessary that the surface area of the electrodes and the distance between them should remain constant or nearly so. In the Dubilier apparatus the electrodes are connected as shown in Fig. 4, in which it will be seen the distance between them is always the same, although the arc is constantly strained. By making the electrodes large and by revolving them constant oscillations of the highest possible amplitude with a given primary voltage can be produced, for the arc is strained to the greatest extent. If the spokes or inner electrodes are coned as shown in Figs. 4 and 5, so that there is always an equal active surface area, and the end of the outer electrode is given a cylindrical surface as shown in E_1 (Fig. 4), then the arc between these two electrodes will first give undamped oscillations as in the part marked x of Fig. 3; but when the electrode E_2 arrives at the bottom of the electrode E_1 (namely the point E_3) the arc

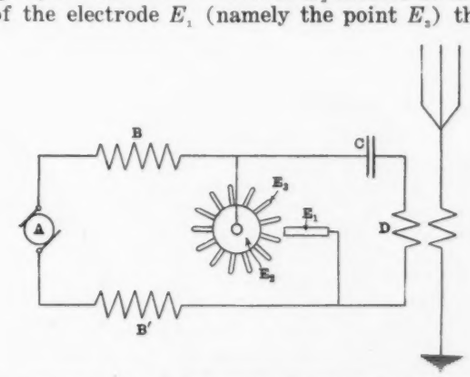


FIG. 5—DIAGRAMS OF CIRCUITS WITH ROTATING SPARK-GAP

will be suddenly broken, and, owing to the inductance coils B, B' (Fig. 5) and to the voltage of the generator A, the condenser C will suddenly be charged to a much higher potential than that given by the undamped oscillations. After the arc is broken, the oscillating circuit E_2 C D (Fig. 5) is open, so that radiation takes place as with a quenched spark. In Fig. 5 A is a generator, B and B' are choking coils, C is a condenser, E_1 is a fixed electrode and E_2 is a rotary device carrying a series of electrodes E_3 which pass rapidly across the end of the electrode E_1. By giving the rotary device a speed of 1500 r.p.m., or twenty-five revolutions per second, thirty spokes or electrodes being used, 750 trains of waves per second are obtained. Recent advances in the construction of portable apparatus by Dubilier are then described. The article is to be concluded.—London *Electrician*, Dec. 12, 1913.

Miscellaneous

United States Tariff Bill and Germany.—H. OESTREICHER.—A review of the new American tariff bill and its relation to the German electrical industry. While it is stated that the average tariff on electrical products of 40 per cent has been reduced to 28 per cent, the duty is still believed to be prohibitive for German competition since "the American electrical industry can sell its products in the United States at a price 30 per cent less than its German competitor."—*Mitt. Siemens & Halske*, November, 1913.

Refractory Insulating Material.—A note on a recent British patent (No. 25,370, 1912) of the British Thomson-Houston Company and the General Electric Company of this country. Silica, carbon and rutile are heated in an electric furnace until reduction takes place. The sublimate is condensed. A mixture consisting of fifteen parts silica, twelve parts carbon and twenty parts rutile, treated in a "smothered-arc" furnace, is claimed. The sublimate has a flaky, laminated structure and contains silicon, carbon, oxygen and titanium. Its apparent density varies from 0.06 to 0.16 and the real density is about 2.56.—London *Elec. Eng'ing*, Dec. 4. 1913.

Apprenticeship.—An outline of the apprenticeship courses on the Werner works of Siemens & Halske.—*Mitt. Siemens & Halske*, October, 1913.

Book Reviews

MICA. Its History, Production and Utilization. By Hans Zeiller. London, England: D. Jaroslaw. 85 pages, illus.

A very interesting little book dealing with mica from many different standpoints, the electrical engineering aspect being kept in the background by the wealth of other material. The chapters of the book deal with the following subjects: Introductory, historical, physical properties, chemical properties, geological occurrences, production and working, applications and statistics. The book will commend itself not only to electrical workers, who are brought closely into touch with this valuable substance, but also to all classes of the reading public.

OVERHEAD ELECTRIC POWER TRANSMISSION. Principles and Calculations. By Alfred Still. New York: McGraw-Hill Publishing Company, Inc. 310 pages, illus. Price, $3.

A good practical engineering treatise on the construction and operation of overhead transmission lines, from the electrical engineering standpoint. The eight chapters of the book deal with the following topics: Introductory, principles, economics, electrical calculations, lightning protection, continuous-current transmission, mechanical principles, supports. A series of seven valuable appendices follow on special and less simple detailed subjects. The treatment is clear and well adapted for electrical engineering students. The chapter on the Thury system gives perhaps the best account of that system in the English language which has yet appeared.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Porcelain Socket

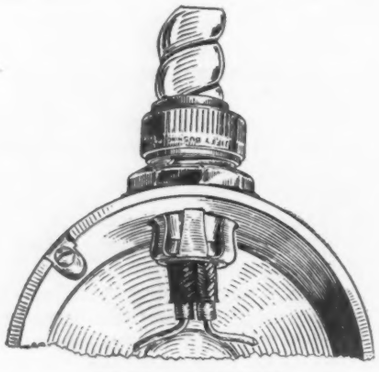
The Pass & Seymour Company, Syracuse, N. Y., has put on the market a new porcelain socket which is an addition to the line of interchangeable porcelain sockets already manufactured by the same company. The

INTERCHANGEABLE PORCELAIN SOCKET

socket is equipped with a 0.5-in. aluminum cap, and as illustrated herewith has a key which is used for snap-switch operation.

Metallic Conduit Bushing

The Fullerton Electric Company, 109 West Twenty-sixth Street, New York, is placing on the market a steel conduit bushing which is illustrated herewith. This bushing is so constructed that it can be inserted quickly in the opening of a box from the outside and can be clamped tightly by means of a lock-nut with a sharp edge which will cut through the enamel on the box and make a perfect ground. This lock-nut works on saw-toothed threads cut in the bushing. Two sets of tempered spring fingers of different lengths are provided, the shorter fingers butting against the inner surface of the box and the longer ones being compressed against



CONDUIT BUSHING

the wall of the opening to make a good ground connection. An eccentric lock inside the bushing is used to clamp the metallic sheath of the cable. An ordinary pair of gas pliers is the only tool necessary for installing this Jiffy bushing, as it is called, and a quarter turn of the bushing is sufficient to fasten the device firmly to the box.

Pipe Taplets

The pipe taplets shown in the accompanying illustrations are designed for use where several different circuits controlled from the same point run for some distance in the same direction. By installing at the control point one of these "gang" type taplets which will hold two, three or four switches, the necessity of using two,

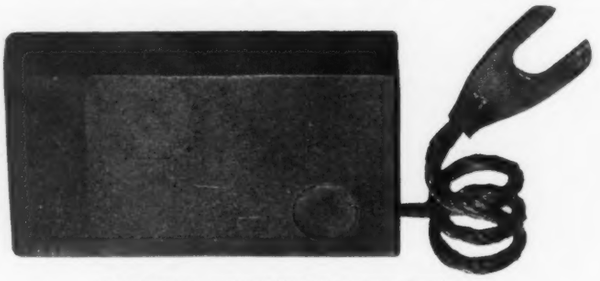
FIGS. 1, 2 AND 3—TWO, FOUR AND THREE-GANG PIPE TAPLETS

three or four conduit lines all the way from the distributing box is eliminated, and the wires for all the circuits may be carried in one conduit to the point where they are to be separated. Either X-pipe or T-pipe taplets are used at the points where the circuits branch off.

These taplets are the product of the H. T. Paiste Company, Thirty-second and Arch Streets, Philadelphia, Pa.

Flexible-Cable Connections for Carbon Brushes

The National Carbon Company, Cleveland, Ohio, is manufacturing a "pigtail" connection for carbon brushes, which is shown in the accompanying illustration. A counterbored hole is drilled in the brush, and the cable is inserted into the smaller part of the hole from the top. The end of the cable is spread out fan-like in the counterbore; a conducting cement is then tamped in, which after hardening makes a strong mechanical connection. The cement used does not shrink away from the wall of the hole; there is no danger, therefore, of loosening and weakening the connection.

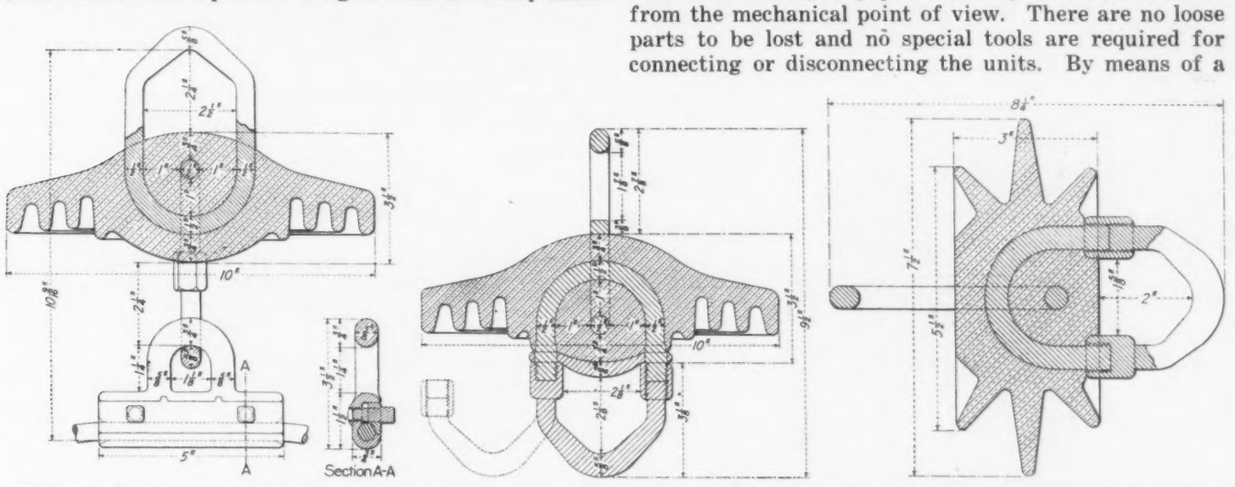


FLEXIBLE CONNECTION FOR BRUSHES

This kind of connection has the following advantages: It contains no solder to melt, and hence there is no danger of overheating; it will not oxidize; the contact drop at the point of contact is reduced to a minimum; the wire can be brought out at any point along the top of the brush, and it can be used on any size or thickness of brush.

Line and Strain Insulators

The line and strain insulators illustrated herewith were invented by Mr. Louis Steinberger and are being put on the market by the Electrose Manufacturing Company, 60 Washington Street, Brooklyn, N. Y. Each insulator is made up of an integral and uniformly solid mass of insulating material with a strain or suspension member embedded therein. The latter is interlinked in such a manner that even if all the insulating material should be removed or destroyed, it would be impossible for the line to fall to the ground.



FIGS. 1, 2 AND 3—INSULATOR WITH LINE CLAMP ATTACHED, SUSPENSION-TYPE INSULATOR, SHOWING MECHANICAL DETAIL, AND STRAIN-TYPE INSULATOR

TEST VOLTAGES

	7.5-in. Disk Strain Insulator, Volts	10-in. Disk Strain and Suspension Insulator, Volts
Line voltage	25,000	25,000
Rain arc value	55,000	55,000
Dry arc value	74,000	100,000
Puncture value, under oil	120,000	150,000

The line clamp has a smooth bore for gripping the wire or cable, thereby preventing crystallization and the possible breaking of the conductor at or near the clamp.

FIG. 4—SUSPENSION-TYPE INSULATOR WITH LINE CLAMP

The clamp is designed to grip conductors of various diameters. It is light in weight, but it is sufficiently strong to break the conductor before any slippage can take place. The metal parts of these insulators are made of galvanized drop-forged steel.

The disk strain insulators are made in sizes having diameters of 5.5 in., 7.5 in., 10.5 in., 12.5 in. and 14.5 in., and the disk strain and suspension insulators in diameters of 8 in., 10 in., 12 in., 14 in. and 16 in. The accompanying table gives test values obtained with the 7.5-in. disk strain insulator and the 10-in. disk strain and suspension insulator.

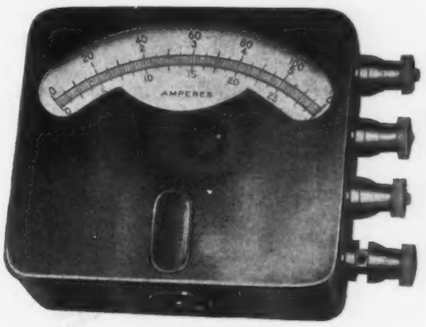
In addition to the excellent electrical characteristics of the insulators, they possess many desirable features from the mechanical point of view. There are no loose parts to be lost and no special tools are required for connecting or disconnecting the units. By means of a plain wrench, a nail or even a piece of wire two or more units may be connected or disconnected in a fraction of a minute.

Close-Reading Pocket Meter

A pocket meter of the direct-current moving-coil, permanent-magnet type, with 120 scale divisions, has been designed and is being put on the market by Mr. Louis M. Pignolet, 78 Cortlandt Street, New York. The scale is 3.25 in. long, and the instrument is of convenient pocket size, being but 4.5 in. long, 3.25 in. wide and 1.25 in. deep.

The moving element is light in weight, reducing to a minimum the friction between its pivots and the jewels. The pivots are carefully polished and ground to a small radius so that ordinary shocks will not cause injury to the jewels or the pivots themselves. Highly polished sapphire jewels are used.

Voltmeters or volt-ammeters can be adjusted for resistance measurements, the resistances being 250 ohms for 0 to 3, or 3.25 volts; 500 ohms for 0 to 6, or 6.25 volts, and so on in the same proportion for the higher voltages. Voltmeters can be provided with scales reading 0.025, 0.05, 0.10, 0.25, 0.5, 1.0 and 2.0 volts, and ammeters with scales reading 0.01, 0.05, 0.10, 0.25 and 0.5 amp. The instrument is inclosed in a hand-sewn solid-leather case.



POCKET METER

Transformers for Mill Service

The transformer illustrated herewith is one of nine units installed in one of the mills of the United States Steel Corporation. These transformers are designed particularly for heavy steel-mill service, and they operate continuously twenty-four hours a day with frequent overloads. The units are of the twenty-five-cycle water-cooled, core type and are rated at 2000 kva, being designed for 22,000 volts high tension and 2200 volts low tension.

2000-KVA TRANSFORMER FOR MILL SERVICE

The core type was used because of its mechanical strength, which enables the apparatus to stand up under the heavy stresses often met with in operation while at the same time securing the maximum cooling effect from the circulating oil.

Several hundred separate oil ducts traverse the interior of the coils of the windings. These ducts are so spaced that no part of the copper is more than 0.25 in. from free circulating oil. The completed windings are impregnated solidly and are sectionalized so that the coils may be removed without destroying the whole winding. These transformers have a high reactance, which acts as a protection against surging or "shorts" on the secondary lines.

Each of the nine units is designed to carry a normal full load of 18,000 kva with an increase in temperature of 40 deg. C., and a load of 36,000 kva for a period of two hours without injuring any part of the transformer. Such an overload of 100 per cent for a period of two hours is said to take care of any ordinary peak load. This overload capacity is declared to result from the circulating oil reaching every part of the interior of the windings through the hundreds of oil ducts provided. The hotter the windings become from overload, therefore, the faster the oil travels in dissipating the heat.

In order to prevent the windings becoming distorted on account of sudden rushes of current, surging or "shorts," the coil support is made an integral part of the top and bottom yoke laminations, and separate fittings, bolts, springs or wooden wedges are therefore unnecessary.

The core is rectangular in shape and is made of silicon steel. Oil channels are provided through its interior at points where the maximum cooling effect may be obtained from the circulating oil. These channels are arranged so that the warm oil flows upward. The transformer tank is made of boiler plate. All the seams and joints are welded and no rivets are used. The transformers are shipped with the oil, core and coils in the tank complete, to eliminate the necessity of drying out the windings before installation. The tank rests on a cast-iron pedestal, and two eye-bolts pass through the cover of the pedestal, for lifting the entire apparatus.

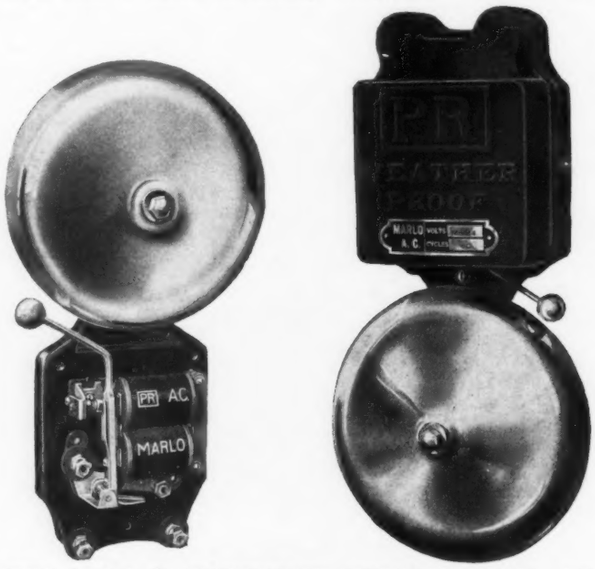
The original installation in the steel mills referred to was made three years ago, and consisted of six 2000-kva transformers. Three duplicate units have been added recently to bank with the six already in service. Each unit weighs approximately 42,200 lb. and they are said to be among the largest core-type transformers in this country.

The transformers described are the product of the Pittsburgh Transformer Company, Pittsburgh, Pa.

Transformer Bells

The bells illustrated herewith are being put on the market by the P R Manufacturing Company, Detroit, Mich., and are used with bell-ringing or sign-lighting transformers. They are manufactured in sizes ranging from 2.5 in. to 12 in. In external appearance these bells are similar to those developed by the same company for use with batteries or 110-volt direct-current or alternating-current circuits.

In Fig. 1 is shown a "Marlo" bell for interior work with the cover removed, disclosing the working parts. The bell is equipped with enameled-wire magnets, laminated cores, two sets of binding posts and carbon contact points. The armature is hinged and has flexible rear adjustment and a sliding-spring contact. The device is mounted on a wrought-metal base which is heavily embossed. For the 5-in. to 12-in. sizes the base is approximately 12 in. long and 6 in. wide. The bell is provided with a sheet-metal cover finished in "Bauerbarff." The "Marlo" bell shown in Fig. 2 is designed for outdoor operation. It has a cast-iron weather-proof cover which incloses the entire base. The back is covered with a thick insulating compound which is impervious to moisture. An apron can also be provided to protect the striker arm and gong.



FIGS. 1 AND 2—TRANSFORMER BELLS FOR INDOOR AND OUTDOOR SERVICE

A cheaper type of transformer bell known as the "Eclipse" is manufactured by the same company. It does not have two sets of binding posts or a pivoted armature, but in other respects it is similar to the "Marlo."

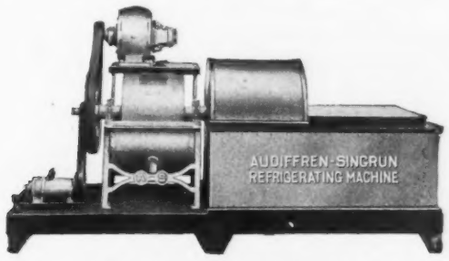
When operating small bells on the same circuit with

large bells the transformer connections should be arranged to give a secondary voltage of from 12 volts to 24 volts. Special windings can be supplied for 25-cycle, 30-cycle, 40-cycle, 50-cycle or 60-cycle alternating current. The transformers should be located as near the bells as possible to prevent excessive voltage drops in the secondary circuits.

Refrigerating Machine for Household Use

The refrigerating apparatus shown in the accompanying illustration was invented by Abbé Marcel Audiffren, a French professor of physics. It is called the Audiffren-Singrun refrigerating machine and is manufactured in America by the H. W. Johns-Manville Company, New York. The machine is small and simple in construction and is particularly adapted to family refrigeration. Neither ammonia nor carbonic acid is used, and temperatures can be secured lower than those obtained with ice. A dry cold results, which is more sanitary than that obtained with ice. The machine is also designed to make ice in small quantities if desired.

In appearance the Audiffren-Singrun refrigerating machine resembles a large dumbbell with a pulley on the end. It consists of a shaft having a hollow drum on one end, another drum at the middle, and a pulley at



HOUSEHOLD REFRIGERATING APPARATUS

the other end, the latter being connected by a belt to a small motor. The machine is supported horizontally by two bearings, one on each side of the drum at the middle of the shaft. When the machine is revolved in these bearings the end drum becomes cold and the drum at the middle becomes warm. Water is supplied to cool the latter, while the cooling effect of the end drum is used to refrigerate brine (common salt and water), which is circulated through cooling coils that may be placed wherever convenient.

The liquid is evaporated in the drum at the end of the shaft, and the gas resulting from this evaporation is drawn into the middle drum through a passage in the shaft. The gas in this middle drum is compressed and returned to the liquid state after giving out its heat. It is then allowed to pass back to the end drum through a second passage in the shaft to be re-evaporated and to go through a similar cycle of operation.

The working parts of the machine are hermetically sealed within the drums and are lubricated by a bath of oil, which together with the refrigerant is applied in the factory and remains permanently inside the drums.

A refrigerator equipped with cooling surfaces is supplied with one of these machines. These surfaces are kept cool by the brine pumped from the machine. The apparatus is designed so that it starts and stops automatically under the control of temperatures in the refrigerator being cooled. The ice frozen by these machines is made from the same supply from which the drinking water is drawn.

Portable Electric Tools

The electric portable buffer shown in Fig. 1 is operated through a flexible shaft by a small motor and is used to polish brass signs and metal work in offices, hotels and engine rooms. For burnishing silver and other light work a ⅛-hp motor is used with either alternating or direct current, and for heavier work a 1/6-hp motor is provided for use on alternating current and a ¼-hp motor for direct current. As shown in

FIG. 1—ELECTRIC BUFFER USED IN POLISHING METAL SIGNS

the illustration, the motor can be carried easily in one hand and the work done with the other. Buffing wheels measuring 2 in. by 3 in. and 3 in. by 1 in. are used for the lighter work, while a 4-in. by 1-in. wheel is available for heavier service.

In Fig. 2 is shown a tool-post grinder used in grinding centers, dies, cutters, etc., arranged either with or without hand feed. This device will do both internal and surface grinding. Motors are supplied for operating on either alternating or direct current at 110 volts or 220 volts. The machine is equipped with a 0.375-in. by 6-in. emery wheel, an internal grinding attachment, 10 ft. of flexible cord and a plug to fit any standard lamp socket.

The electric breast drill illustrated in Fig. 3 is used

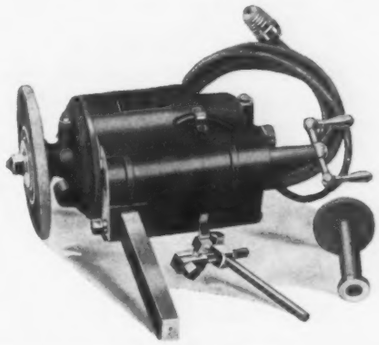


FIG. 2—ELECTRIC TOOL-POST GRINDER

with standard-sized drills up to 5 in. in diameter. The switch is placed in the handle. The reduction gears are designed so that power is transmitted equally from opposite points on each gear. For alternating current with 110 volts or 220 volts the device weighs 22 lb. It is 15.5 in. high including the chuck, and 13 in. without. The diameter of the body is 5.75 in. and it will drill holes up to 0.5 in. in diameter in iron or steel and

0.75 in. in diameter in hard wood when equipped with a Jennings bit. The equipment for 110-volt and 220-volt direct current weighs 20 lb. It is 16.5 in. high with the chuck and 13.5 in. without. The diameter of the body is 5.75 in. and it will drill holes up to 0.5 in.

FIG. 3—ELECTRIC HAND DRILL

in diameter in iron or steel and 1 in. in hard wood with a Jennings bit.

These tools are the product of the Stow Manufacturing Company, Binghamton, N. Y.

Electric Equipment for Mining Company

The property of the National Copper Mining Company in the Coeur d'Alene district of Idaho is being equipped with electric machinery supplied by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. An aggregate of 300 hp in induction motors will be used at the mine, the largest unit being a 200-hp machine for driving an air compressor. The mill, which has been designed and is being built by the General Engineering Company, Salt Lake City, Utah, will also be driven by induction motors with a total of 600 hp.

Electric haulage will be used underground to handle the ore, which will also be transported from the tunnel mouth to the mill over an electric railway. The run from the adit to the head of the mill is about 10,000 ft., and in this distance there is a drop of 450 ft., necessitating a grade of 4.5 per cent on the railroad. The railroad is built along the side of Dead Man's Gulch; it has a 24-in. gage and is laid with 30-lb. rail. The ore will be transported down this railway in trains of from eight to twelve cars, each car carrying from 4 tons to 5 tons of ore. The equipment is designed to handle a tonnage of 500 tons in two shifts of eight hours each. The average haul within the tunnel will be about 5000 ft. and the grade on this inside run will only be 0.5 to 1 per cent. A 4-ton electric locomotive will be used for work inside the tunnel. This locomotive can be operated in tandem with another 4-ton unit for hauling ore from the mine to the mill. It was originally intended to install a gravity tram to take care of the transportation of the ore from the adit to the mill, but a careful investigation proved that an electric railway could handle the ore considerably cheaper on the steep grade involved. The installation cost of the railway is a little less than the estimated installation cost of an aerial tramway.

The electric haulage system has been designed by Mr. F. Cushing Moore, chief engineer of the National Copper Mining Company, in conjunction with the engineers of the Westinghouse company.

Storage Battery Equipment

At the Wisconsin State Fair held recently at Milwaukee the Edison Storage Battery Company, Orange, N. J., had on exhibition a lighting equipment for small rural installations. The instrument panel, the automatic voltage controller, and a bank of lamps, the last-named being supposed to represent the lighting equipment of a typical farmhouse installation, were mounted on a large table with a mahogany finish. The automatic controller kept the voltage at the lamps normal at all times, whether the battery was being discharged or charged. A voltmeter with a double-throw switch was mounted in the middle of the rear of the board, and showed the voltage of the line between the controller and the dynamo when the battery was being charged and also the voltage of the line across the lamps after its regulation through the controller.

A gasoline engine and dynamo were placed alongside the table, and the battery rested on a shelf beneath. A simplified charging panel was also mounted on the back of the demonstration table and was equipped with one double-pole switch with fuses, an ammeter and an underload cut-off for opening the circuit in case the engine should stop, thereby preventing the battery from discharging into the dynamo and running it as a motor.

Automobile-Tire Pump

The portable electric tire pump shown herewith is the product of the United States Electrical Tool Company, Cincinnati, Ohio. A 0.5-hp motor, which can be connected to any convenient lamp socket, is used to drive the apparatus. The switch for stopping or starting the machine is located on the motor. Lubrication is provided by means of grease cups on the cylinder

ELECTRIC TIRE PUMP

and the crank-shaft bearings. The tank is 6 in. in diameter and 12 in. high and is fitted with a pet-cock at the bottom to blow out the liquid which condenses therein. A flat 35-in. by 4-in. tire, the manufacturers claim, can be pumped to a pressure of 70 lb. in one minute and thirty seconds. The complete outfit weighs 130 lb.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Moloney Transformer Activities in Canada and United States.—The Canadian Moloney Electric Company, with capital of $150,000, was superseded on Nov. 28, 1913, by the Moloney Electric Company of Canada, Ltd., with capital of $300,000. The home office of this company is in Windsor, Ontario. The parent company is the Moloney Electric Company, of St. Louis, with a capital of $700,000, so that the total for the two companies is now $1,000,000. The doubling of the capital of the Canadian company indicates the growth of the business in Moloney transformers in the Dominion.

Large Increase in Sale of Heating Appliances Recorded.—From G. M. Stuart, president of the Stuart-Howland Company, of Boston, Mass., comes a letter telling of the large increase in business of that concern during the past year. In it he says: "We have within the last year added seven traveling salesmen to our sales force; and our sales have largely increased, notwithstanding the somewhat less favorable conditions which prevail in the trade throughout the territory we cover. We have been specializing on line material, fixtures, tungsten lamps and electric heating material, and our business in the latter line has increased more than 5000 per cent in five years. In other words, the sales on all kinds of electric heating material for the last year were more than fifty times what they were five years ago."

Manufacturers' Association Inaugurates Export School.—An "export school" has been establshed at the New York headquarters of the National Association of Manufacturers, where employees of its members may receive such theoretical and practical instruction in exporting as to allow them wider success in the field of international trade. The school represents part of a movement to boom the export business and place this country on a par with England and Germany in this field, and its inauguration, almost simultaneously with an effort on the part of the Bureau of Foreign and Domestic Commerce to extend the benefits of the consular service, is evidently in response to a general demand for an increased outlet for American goods. At present two courses are offered—elementary export trade and foreign exchange—which are given on Tuesday and Friday evenings respectively. Over fifty have enrolled for these courses, which consist of lectures by Vincent Gonzales, the Latin-American and banking expert of the association. The preliminary effort has been so well received that there is some talk of extending the course to include all of the subjects of large importance in connection with foreign trade.

Profit-Sharing Plan Continued.—The following letter, sent out recently to employees of the Detroit Insulated Wire Company, of Detroit, Mich., tells of the practice of that concern in regard to the division of its profits with its employees. The letter reads: "The company is pleased to announce again that as a result of our combined effort it is able to make distribution of a portion of its profits to its employees, as in former years. Salaried employees who have been in our employment continuously for twelve months or more will receive a donation of 1 per cent of their entire salary for the period ended Dec. 15, 1913. Hourly rate employees who have been in our employment continuously for twelve months or more will receive a donation of 2 per cent of their entire wages for the period ended Dec. 10, 1913. The company cannot guarantee similar donations from year to year, but it is hoped a distribution can be continued. This reward is for faithful and continuous employment in order to emphasize the fact that continuity of service is mutually profitable. As heretofore, we are depositing the amount of the donation to the credit of each employee in the Michigan Savings Bank, and to each employee will be presented a pass book or deposit slip with the donation entered therein or thereon. It is hoped that for your benefit you will permit the deposit to remain, adding to it from time to time out of your wages. An employee with a bank account is worth more to his employers than one without, for the reason that it encourages thrift and industry. Your pass book or deposit slip will be handed to you on Wednesday, Dec. 24, at quitting time."

Recent Westinghouse Orders.—A number of public utility companies are mentioned in the latest report of the Westinghouse Electric & Manufacturing Company as purchasers of electrical machinery and equipment. The Greenville (Tex.) Railway & Light Company has ordered through the Albert Emanuel Company one 200-kw, 600-volt direct-current, three-phase, 60-cycle, compound-wound, self-starting rotary converter, together with a switchboard for controlling the same. From the Salt Lake & Utah Railway Company, Salt Lake City, Utah, an order has been received for six 250-kw, 750-volt direct-current, three-phase, 60-cycle, self-starting rotaries; six 150-kva, single-phase, 60-cycle transformers and two switchboards of seven panels each. An order has been placed by the Chambersburg & Shippensburg Railway Company, of Chambersburg, Pa., for one 200-kw, 600-volt direct-current, three-phase, 60-cycle, self-starting rotary converter; three 75-kw, single-phase, 60-cycle transformers and one control switchboard. The Sand Springs Railway Company, Tulsa, Okla., has ordered one 200-kw, 600-volt direct-current, two-phase, 60-cycle self-starting rotary converter; two 110-kva, single-phase, 60-cycle transformers and a switchboard for the control of the same. An order for one 500-kw, 600-volt direct-current, six-phase, 60-cycle, self-starting rotary converter, three 185-kva, single-phase, 60-cycle transformers and a control switchboard has been placed by the Greenville (S. C.) Traction Company. The House of the Good Shepherd, Boston, Mass., has purchased one 100-kw, 125-volt, compound-wound, direct-current, engine-type generator. Two 110-kw, 250-125 volt, three-wire, compound-wound, engine-type generators, with field rheostat and balance coils, are being made for the Seattle (Wash.) Lighting Company.

Transmission Line Tendencies During 1913.—Hubbard & Company, of Pittsburgh, Pa., manufacturers of pole-line hardware, give the following summary of the tendencies they have noticed in their field during the past year: "We have noted during 1913 an increasing tendency toward the use of the highest grade of material obtainable. More and more companies are calling for braces, bolts, rods and clamps made in accordance with either the A. T. & T. or N. E. L. A. specifications. Nearly all of the larger operating companies in the central-station, telephone and telegraph fields have appointed committees, composed of practical construction men, to standardize the methods and materials used in such work, and these bodies, together with the large engineering societies, have done much to promote the general use of a better grade of line hardware. The most remarkable feature of the year's developments, however, is the rapidity with which steel is replacing wood. Although most apparent in high-voltage lines, this change is affecting all overhead construction. In transmission work there is a very urgent call for a steel pole of moderate cost, which, spaced 200 ft. or 300 ft. apart, will furnish a permanent type of construction at about the same cost as the old short-span wooden-pole lines. The majority of new lines of less than 60,000 volts are limited to a single circuit, the practice being to follow a separate route when an additional circuit is necessary. This arrangement greatly favors the use of a steel fixture, combining arms, braces, and, in the lower voltages, pins and ground-wire supports. These fixtures give permanence and safety to

construction work at a cost which is actually less than that of a good grade of wood construction, owing in part to the lower cost of installation on poles. There is a noticeable tendency in recent practice to increase the wire spacing for a given voltage, probably on account of a desire to raise the voltage at some future time. About 90 per cent of the lines recently built are equipped with overhead ground wires, and many companies are installing such protection on all their older lines, as its efficacy seems to have been proved, assuming the wire to be properly clamped to a well-designed bayonet. In some quarters there is an objection to the use of grounded metal arms, which is met by tying the ground wire on a small insulator screwed on a steel-spring thread on the end of the bayonet. When desired, the ground wire is used as the neutral of a four-wire three-phase system. The clamp pin is rapidly replacing the wooden and malleable types for all kinds of high-tension and low-tension service with wooden arms, because its use develops the full strength of the arm instead of half the strength, as in the old type of pin. There are no holes to allow water to reach the heart of the arm and cause decay and splitting, and the saving in maintenance charges will pay for the pins many times. In one large system clamp pins are used exclusively, and on this account the fir cross-arms used are guaranteed by the supplier to last twenty years. We intend to place on the market in a short time a metal arm designed to replace the wooden article and possessing the advantages of safety, permanence and low cost. Series tungsten street lighting, already crowding the arc lamp, has received an additional impetus through the development of the nitrogen-filled type of tungsten lamp. The present-day policy of supplying power to all sizes of consumers has produced some problems in the proper supporting of transformers on poles, and the best solution seems to be to use angle and channel steel platforms for one or more poles, depending on the size and number of units required." Hubbard & Company have experienced an increase of 107 per cent in their business for the first eleven months of 1913 over the figures for the corresponding period of 1912. This increase compares with 62 per cent for 1910, 78 per cent for 1911 and 98 per cent for 1912, the percentages indicating in each case the increase in sales figures over those for the preceding year.

First Aid to Exporters Planned.—The Bureau of Foreign and Domestic Commerce, a subdivision of the Department of Commerce, has opened an office in the custom house, New York City, and will shortly open offices in Chicago, New Orleans and San Francisco. An experienced member of the staff of the bureau will be in charge in each city for the purpose of giving information concerning the work of the bureau and to assist merchants and manufacturers in the development of foreign trade. The publications of the bureau will be on file, and these offices will be made sources of information and assistance to all desiring to cultivate export business. A special feature of the work at these offices, which will undoubtedly interest business men and commercial organizations generally, is an arrangement made with the consular service whereby consuls who are in this country on leaves of absence will visit the offices of the bureau and make them places for meeting business men interested in their particular fields. Advance notice of these consular visits will be given through the daily trade reports of the bureau, by special notices to business houses which have filed their names with the bureau as interested in some special field, and through notices to the trade and commercial organizations of the city and district in which the office to be visited is situated. It is planned also to have the commercial agents of the Department of Commerce use these offices in the same way as the consuls for laving their information before interested parties in person. The above plans are expected to carry a twofold benefit. In the first place, they will enable the merchant or manufacturer to get in closer personal touch with the particular foreign field in which he is specially interetsed and to ask questions which will draw out the details of primary interest to himself. Secondly, the personal contact with these exporters is expected to be of large benefit to the consuls and commercial agents, giving them the best possible idea of the questions of primary interest to the exporters in their respective fields, and thus enabling them to make the best of their opportunities when abroad. In other words, as stimulators of international trade, it is coming to be realized that these representatives should be kept in fairly close contact with the trade conditions of both the foreign and the domestic fields. To further this educational work it is planned, in addition to the innovations previously mentioned, to have these commercial representatives, while in the United States, attend important conventions of trade conferences of persons or organizations interested in the special lines of investigation in which they are engaged. This will give the representative the same insight into general trade conditions that the personal interviews will give as to individual needs, and it will be supplemented by visits to the important centers of production of the product or products in which he is particularly interested.

Employees' "Suggestion Plan" of the Automatic Electric Company.—In recognition of helpful suggestions made during the past year, fifty employees of the Automatic Electric Company of Chicago, manufacturer of automatic telephone apparatus, were presented with watch fobs at a banquet given by the firm's employees on Dec. 22, 1913. The presentations were made by Joseph Harris, president of the Automatic Electric Company, who thanked those who had won recognition for the interest they had displayed in their work. Mr. Harris also took occasion in the course of his remarks to congratulate all present upon the success that had come to them during 1913, saying that in quality and volume of output the past twelve months had been the most satisfactory since the beginning of the manufacture of automatic telephone apparatus twenty-two years ago. The "suggestion plan" has been the means of materially improving the shop methods of the Automatic Electric Company's factory, adding to the efficiency of the organization and eliminating many causes of waste and expense. The entire plant was planned and systematized by efficiency experts of recognized ability, but in numerous cases it has been found that the "man on the job" has been able to improve certain details of that system. In its original form the "suggestion plan" consisted simply of an invitation to all employees to submit to the factory superintendent any ideas which might occur to them from time to time which would, in their opinion, improve the existing methods of production. Printed forms were supplied upon which to outline the suggestion. After inspecting them the factory superintendent refers the suggestions to engineers, who investigate and report upon any changes in design involved and the probable future yearly demand for the particular articles affected. Estimates are also made as to the cost of new machines, tools and fixtures required, the saving per unit and the total yearly saving. Upon these reports the factory superintendent bases his decision to accept or reject the suggestions. The advantages of the plan are twofold. By it the company secures the benefits of the employees' observations at small extra expense, while at the same time the employees whose suggestions are found of value have the honor of wearing the medals presented and of seeing their suggestions put to practical use.

NEW YORK METAL MARKET PRICES

	Dec. 22		Dec. 29	
	Bid	Asked	Bid	Asked
Copper:				
Standard, spot*	.....	.....	14.37½	to 14.87½
	Selling prices		Selling prices	
	£ s. d.		£ s. d.	
London, standard, spot*	64 3 9		66 6 3	
Prime Lake	14.50	to 14.75	15.25	to 15.50
Electrolytic	14.12½	to 14.37½	14.75	to 15.00
Casting	13.87½	to 14.12½	14.50	to 14.62½
Copper wire base	15.50	.....	16.00	.....
Lead	4.00		4.15	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.25		7.25	
Spelter, spot	5.15	to 5.25	5.30	to 5.35
Tin, spot	36.62½	to 37.00	37.62½	to 37.87½
Aluminum:				
Prompt delivery	18.50	to 19.00	18.50	to 19.00
Future	18.50	to 19.00	18.50	to 19.00

*COPPER EXPORTS

Heavy copper and wire	13.50	13.50
Brass, heavy	8.75	8.75
Brass, light	7.75	7.75
Lead, heavy	3.95	4.05
Zinc, scrap	4.37½	4.37½

*OLD METALS

Total tons to Dec. 29 26,658

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Ohio Utility Plans Stock Increase.—At the annual meeting to be held in Akron, Ohio, on Jan. 24, the stockholders of the Northern Ohio Traction & Light Company will be asked to authorize an increase in the 6 per cent preferred stock of the company from $3,000,000 to $5,000,000. They will also be asked to approve the directors' plan, providing for the payment of the normal income tax on all of the company's bonds. This will prevent deductions on coupons deposited for collection.

Two Operating Companies in the Northwest Prospering.—A short note received from the Aberdeen (S. D.) Light & Power Company and the Columbus (Neb.) Light, Heat & Power Company tells of satisfactory increase of business for both concerns during the past year. The first-named company put a new steam plant into operation last January and is contemplating the possible need for an additional generating unit during 1914. The second company has enjoyed an increase of 20 per cent in its connected load during 1913, and to help take care of the increase a third unit, consisting of a cross-compound condensing engine directly connected to a 500-kva alternator, was added to the plant equipment during that year. About 100 hp additional load has been contracted and will be connected in the early spring months. This company reports that electric cooking devices are attracting some attention at the present time in its territory. Willis Todd, Omaha, Neb., is general manager of both companies.

Philadelphia Electric Company Gains Large Customer.—For some time it has been expected that the Pennsylvania Railroad, in providing for the electric power requirements in connection with its proposed electrification plans, would turn to the Philadelphia Electric Company as the cheapest and most reliable source. It is only just announced officially, however, that this policy will be carried out. The contract with the electric company calls for a minimum of 3750 kw for the electrified section of the main line, but it is estimated that the actual consumption during the first year will be very largely in excess of that figure. At the present time the electric company's largest customer is the Philadelphia Rapid Transit Company, which has recently increased its contract to 35,000 kw. The above and other growing demands for electric service will be partly cared for by the installation of what will be the largest single unit generating sets in the world, which have been ordered by the Philadelphia Electric Company from the General Electric Company. These units, rated at 35,000 kw and 30,000 kw respectively, will call for the erection of an entire new generating station in Philadelphia.

Montana Power Company Planning Increased Generating Equipment.—The Montana Power Company was incorporated a year ago, as a consolidation of a number of hydroelectric properties operating in Montana. It owns a number of steam and hydroelectric generating stations and has undeveloped water-power sites, with a total estimated capacity of 280,000 hp. The transmission lines of this company connect the cities of Butte, Great Falls, Billings, Livingston, Bozeman and Lewiston, Mont., and other towns in the neighborhood, and electrical energy is furnished by it for use in the copper mines of the district and for the operation of electrified mountain sections of steam railroads in addition to the other more familiar and usual applications. In order to take care of the increased demand for power which will fall upon this company when the electrification of the Chicago, Milwaukee & St. Paul Railway is completed, it is planning the development of several of its water-power sites. Financially the company is in very good condition. Its initial dividend was paid on April 1, 1913, and it is estimated that the net earnings for the current year will be over $2,500,000. The outstanding capital stock of the company is $49,634,000 common and $9,700,000 preferred. Its bonded debt amounts to $15,146,000.

New Milliken Brothers Company Formed.—Milliken Brothers, Inc., is the name of a new corporation just formed for the purpose of taking over the plants of the old concern by the same name and continuing its business. The operating management of the former company is retained by the present one, which will have $1,000 000 quick assets, in addition to the real estate, buildings and equipment acquired from the old company. Provision has been made for increasing the equipment of the plant, so as to render possible a larger production, and the present plans contemplate active pushing of both the domestic and export trade. The new company is prepared to bid on all kinds of structural steel work, including buildings, bridges, tanks, transmission-line towers and other similar applications. The location of the fabricating plant of the company is at Milliken, Staten Island, N. Y., and the offices of the concern are at 5 Nassau Street, New York. Its officers are William Salomon, president; Francis Dykes, vice-president; G. E. Barrett, secretary, and A. A. Cannon, treasurer. The board of directors consists of J. S. Bache, F. G. Corning, Thomas Denny, Francis Dykes, C. McK. Lewis, W. B. Parsons, William Salomon, W. J. Saunders and C. B. Tyler. The former Milliken Brothers company was incorporated in New York on May 16, 1902, and on Jan. 10, 1906, it took over the steel business established in 1857 by Samuel Milliken, Jr. In February, 1913, the company went into the hands of receivers in default of a small payment to creditors and of payment of interest on the first mortgage bonds outstanding at that time. Committees were then formed to protect the interests of the stockholders and the bondholders. At the time the concern went into the receivers' hands it had an authorized and outstanding capital of $5,500,000, of which $3,000,000 was in 7 per cent cumulative preferred stock. There were also outstanding at this time $3,000,000 of first convertible sinking fund gold bonds, bearing interest at 6 per cent, and $3,691,982 of ten-year adjustment notes.

Semi-Annual Report of the Colorado Power Company.—The report of the Colorado Power Company for the six months ended Sept. 30, 1913, includes an extended review of the operating and industrial conditions in the territory served by G. H. Walbridge, president of the company, as well as a statement of the financial condition of the concern by its treasurer, D. E. Houston. Mr. Walbridge said in part: "The company acquired the properties and franchises of the Central Colorado Power Company and the Leadville Light & Power Company, free of encumbrance, on April 14, 1913. It acquired the stock of the Salida Light, Power & Utility Company, free of encumbrance, on July 21, 1913. This stock was purchased by the bankers for the benefit of the Colorado Power Company on March 1, 1913, and was turned over to the company at cost and interest on July 21, 1913. It is expected that the physical property and franchises of that company will be transferred ultimately to the Colorado Power Company. During the past six months the companies have secured power contracts estimated to produce an annual gross revenue of about $110,000, and have lost business due to suspension of operations by retail power customers yielding an annual revenue of about $17,000, giving an estimated net annual increase from new business secured of about $93,000. About one-half of the above net increase will come from a contract with the American Smelting & Refining Company, covering the supply for ten years of all power used by the Arkansas Valley Smelter, near Leadville, Col. Of the total power required, only one-sixth has been in operation, and for but four months out of the period. The full revenue from this contract will not begin until February, 1914, the delay being caused by necessary changes in adapting the smelting machinery for electric drive. A contract with the Denver City Tramway Company was signed late in 1911, from which an annual revenue of about $35.000 is expected. Various delays incident to the purchase, installation and adjustment of necessary lines and special transforming apparatus prevented the commencement of full service until about Sept. 1, 1913. The company's physical property has been well maintained and is in excellent condition, and its service has been further improved and continues to be satisfactory to customers. A considerable amount of work has been done in further strengthening troublesome points in the main transmission lines by the addition of towers and stronger cables." The capital liabilities of the company, as shown in the report of the treasurer, amount to $15,555,000, including $11,000,000 of common and $425,000 of preferred stock and $4,130,000 of first mortgage 5 per cent bonds outstanding. The gross operating revenue for the period covered by the report amounted to $333,876, with an operating expense of $107,237, so that a net revenue of $226,639 was realized.

Business Notes

The Greenwich Sales Company has recently opened offices at 257 Broadway, New York, and will represent in the metropolitan district manufacturers of electrical specialties. T. E. D. Ritchie is sales manager of the company.

Barnes & Kobert, of New Haven, Conn., have just appointed R. H. Harper as sales manager. Mr. Harper was formerly manager of the railway department of the Western Electric Company, 463 West Street, New York City.

The Hurley Machine Company, of Chicago, Ill., has just opened a new retail store in New York City, on the ground floor of the Flatiron Building, which will be devoted exclusively to the sale of its washing and wringing machines and vacuum cleaners.

John Bellamy Taylor, formerly associated with the General Electric Company as engineer in its foreign department, has established a consulting engineering practice of his own, with offices at 100 Broadway, New York, and an office and laboratory at Schenectady, N. Y. His field will embrace telephone, telegraph and power transmission engineering.

The Underwriters' Laboratories have recently opened an office in London, England, under the supervision of Messrs. Heap & Digby, consulting electrical engineers. The address of this office is 48 Westminster Palace Gardens. Its establishment resulted from a demand on the part of British manufacturers for a convenient inspection service under the rules by which electrical material and apparatus are specified in Canada.

The Richmond Electric Works, of Richmond, Va., are making preparations to expand their field during the coming year. A New York office has been opened in the Hudson Terminal Building under the direction of C. W. Kragh, whose territory will include New York and Connecticut. The Barber-Dwinnell Electric & Manufacturing Company, of Kansas City, Mo., has just been appointed district sales agent for the same concern, covering the States of Kansas and Nebraska and the western portion of Missouri.

The Standard Underground Cable Company, of Pittsburgh, Pa., has made the following organization changes in consequence of the death of Mr. J. R. Wiley, for nearly twenty years Western manager, with headquarters at Chicago. E. J. Pietzcker, formerly Southwestern sales manager, is now also Western manager in charge of both the Chicago and St. Louis offices of the company; W. M. Rogers has been made assistant Western sales manager, with headquarters at Chicago, and R. C. Houck assistant Southwestern sales manager stationed at the St. Louis office.

New Industrial Companies

The Electric Time Service Company, of Ansonia, Conn., has been incorporated by Clifford B. Burr, Charles G. Burr and Kathryn Burr, all of Derby, Conn. The company is capitalized at $3,000.

The Electrical Safety Device Manufacturing Corporation, of Albany, N. Y., has been incorporated with a capital stock of $20,000 by H. W. Nichols, W. Addison and L. Germain, 552 Fifth Avenue, Brooklyn, N. Y.

The Utilities Engineering Company, of Grand Rapids, Mich., has been incorporated with a capital stock of $25,000 to do a general consulting engineering business for public utility corporations. The incorporators are E. M. Diane, A. L. Snyder and others.

The Multi-Signal Company, of Kittery, Maine, has been incorporated with a capital stock of $100,000 to manufacture and deal in electric signals and articles connected therewith. H. Mitchell is president and H. A. Paul is treasurer, both of Kittery, Maine.

The Utility Motors Corporation has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to manufacture and deal in gas engines, motors, etc. The incorporators are H. E. Latter, W. J. Maloney and O. J. Reichard, of Wilmington, Del.

Trade Publications

Oil-Break Switches.—High-voltage oil-break switches are the subject of Bulletin A4176 of the General Electric Company. Type F, Form K-15, which is illustrated and described, may be operated by any one of several methods referred to in the bulletin.

Storage-Battery Industrial and Mining Locomotives.—The General Electric Company has issued Bulletin A4131, describing its storage-battery locomotives. The bulletin contains an outline of the general conditions under which the use of such locomotives is desirable or advantageous.

Calendar.—The H. M. Hirschberg Company, of 39 East Twentieth Street, New York, has issued a very attractive calendar, peach with rose trimmings on a background of scarlet, which explains by inference the superiority of the "Siemens" flaming-arc lamps and "Plania" carbons which that company imports.

Voltage Regulators.—The Thompson-MacArthur Company, Buffalo, N. Y., has issued an illustrated bulletin fully describing the Thompson automatic voltage regulators. Results of tests with curves and tables showing economies obtained are also given. The bulletin is made up of twenty pages inclosed in an attractive cover.

Fuses.—The Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, Ill., has issued a folder referring to its "Union" non-arcing inclosed fuses and cut-outs and its automobile fuse box. The circular contains a list of prices of refilled fuses and a tabulation of the saving effected by having blown fuses refilled.

Water-Tube Boilers Compared.—The Heine Safety Boiler Company, St. Louis, Mo., has issued a pamphlet which is a reprint of a paper read before the Associated Engineering Societies at St. Louis by Mr. C. R. D. Meier, general sales manager of the Heine company. Comparison is made of the heights of seven different water-tube boilers and of the floor areas required by these various types arranged in batteries. A discussion is also presented of the money saved through the reduced area and height requirements of certain types of boilers.

Electrical Fixture.—A pamphlet issued by the T. R. Almond Manufacturing Company, Ashburnham, Mass., illustrates the Flexo lamp. This lamp is of the portable type, the arm is flexible and can be adjusted to any angle or position, and the rays of light may be directed where most desired. The device is suitable for office, home, school or factory, because of its great convenience and economy. Another interesting pamphlet on the same device is entitled "Light on the Light Question." The application of the Flexo lamp to various machines is illustrated.

Counting Machines.—The National Scale Company, Chicopee Falls, Mass., in a twenty-two-page pamphlet illustrates different types of its machines adapted to weighing various classes of material. These machines are said to give a quick and accurate count of any commodity without the use of tabulated figures or weights, mental calculation or figuring of any kind. The results in pieces, dozens or gross are obtained with accuracy. Its method of operation is described. In another pamphlet recently issued an extended list of some of the users of these scales is given, including a large number of electrical manufacturers.

Industrial Lighting.—The engineering department of the National Lamp Works of the General Electric Company, Cleveland, Ohio, has published a comprehensive bulletin (No. 20) on industrial lighting. This publication deals with the various factors that must receive consideration in the design and operation of an industrial lighting installation. The effects of voltage conditions on the operation of lighting units are clearly explained. Curves showing the performance of incandescent lamps in actual practice are given; different types of reflectors are discussed at length along with their distribution curves; the effect of accumulation of dust on reflectors of different types is illustrated graphically; the principles of illumination design and the method of figuring operating costs are clearly outlined, and the application of modern methods of illuminating engineering is shown by a number of illustrated installations with complete data on each. The information is concisely presented.

Personal Mention

Mr. J. H. Hart, Salem, N. J., has been appointed president of the Pennsgrove (N. J.) Electric Light, Heat & Power Company.

Mr. Samuel Insull, president of the Commonwealth Edison Company, sailed for England on Tuesday of this week for a three weeks' trip.

Mr. Julius G. Koppel has been appointed electrical superintendent of bascule bridges of the Canadian Pacific Railway at Sault Ste. Marie, Ont.

Mr. L. W. Dawley, formerly manager of the De Queen (Ark.) Ice & Light Company, has become associated with the Paris (Tex.) Ice Company.

Mr. Paul Fesoli, of Glens Falls, N. Y., has been appointed manager of the Granville (N. Y.) Electric & Gas Company, vice Mr. T. E. Smith, resigned.

Mr. H. L. Richardson has been elected superintendent of the Sussex Light & Power Company of Laurel, Del., vice Mr. C. C. Stephenson, resigned.

Mr. P. T. Hanscom, electrical engineer of the Great Western Power Company of San Francisco, Cal., has severed his connection with the company.

Mr. Fred Eggleston has been appointed superintendent of the Union Springs (N. Y.) Light & Power Company, assuming part of the duties of Mr. G. W. Hull, resigned.

Mr. R. S. Hale, of the Edison Electric Illuminating Company of Boston, sailed for Europe last week on a honeymoon trip. He was married on Dec. 23 to Miss May N. Wilson, of Boston.

Mr. Leslie R. Hicks has resigned as superintendent of the Fall River (Mass.) Electric Light Company and joined the engineering force of Messrs. Lockwood, Greene & Company, of Boston, Mass.

Mr. Charles B. Kelsey, president of the American Public Utilities Company of Grand Rapids, Mich., has been unanimously chosen for president of the Grand Rapids Association of Commerce.

Mr. George W. Hull has resigned as manager of the Union Springs (N. Y.) Light & Power Company and accepted a position with the Central New York Gas & Electric Company at Clyde, N. Y.

Mr. R. B. Mateer has resigned from the commercial department of the Great Western Power Company of San Francisco and accepted the post of commercial agent of the Southern Sierras Power Company at Riverside, Cal.

Mr. C. P. Myrick has been appointed general manager of the San Domingo (Hayti) Electric Light Company and has severed his connection with the Abington & Rockland Electric Light & Power Company, of North Abington, Mass.

Mr. Walter L. Mulligan, manager of the United Electric Light Company, Springfield, Mass., was presented with a large silver loving cup by the members of the United Electric Light Company's Employees' Relief Association on Dec. 19.

Mr. J. E. Harsh, treasurer and new-business manager of the City Light & Traction Company, of Sedalia, Mo., and formerly connected with Doherty companies at Joplin, Mo., and Denver, Col., has been appointed manager of the Salina (Kan.) Light, Power & Gas Company, vice Mr. W. E. McFadden, resigned.

Mr. D. L. Evans, superintendent of the Sisterville (W. Va.) Electric Light & Power Company, has resigned to accept the position of line chief of the Consolidated Light, Heat & Power Company of Huntington, W. Va. Mr. Evans was formerly connected with the Monongahela Valley Traction Company of Fairmont, W. Va.

Mr. George C. Richards, former Jovian statesman, has been presented by the Chicago Jovian League with engrossed resolutions of thanks expressing the appreciation of his fellow Jovians for his services in bringing about better Jovian relations in Chicago, in the formation of the local organization and in conducting successful rejuvenations.

Mr. A. D. Furlong, for the past two years general manager of the Union Railway Gas & Electric Company, Springfield, Ill., has been appointed general manager of the Saginaw & Bay City utilities companies in Michigan as successor to Mr. J. A. Cleveland, resigned. Previous to his connection with the Springfield company, Mr. Furlong was general manager of the Pontiac (Mich.) Power Company.

Mr. H. M. Waite, until recently city engineer of Cincinnati, has been appointed city manager of Dayton, Ohio. Under the new city charter the city manager, who receives a salary of $12,500 a year, is the administrative director of municipal affairs under the supervision of a commission of five members. Mr. Waite is a graduate of the Massachusetts Institute of Technology. His experience has been gained largely in railroad work.

Mr. John S. Wise, Jr., who has been manager of the Harwood Electric Company of Hazleton, Pa., has been appointed general manager of the Lehigh Navigation Electric Company, Hauto, Pa. Mr. Wise has been at the head of the Harwood Electric Company since its formation and was retained in that capacity on the consolidation of the Harwood Electric Company and the Lehigh Navigation Electric Company. His headquarters will remain at Hazleton, Pa.

Mr. John A. Cleveland, for the past two years general manager of the Saginaw, Bay City and Flint interurban lines and of the gas, electric and railway systems of Saginaw City and Bay City, Mich., has resigned and accepted an advisory position with Hodenpyl, Hardy & Company, controllers of the Commonwealth Light & Power Company. Mr. Cleveland was the guest of honor on Dec. 23 at a farewell dinner given by the various heads of the departments in Saginaw and Bay City at the Sagniaw Club.

Mr. Wallace W. Ryder has been appointed general manager of the western division of the Western Union Telegraph Company, with headquarters at Chicago, vice Mr. T. P. Cook, retired. Mr. Ryder was born at Aurora, Ill., April 6, 1865. He entered the service of the Chicago, Burlington & Quincy Railroad in 1883, and, after holding various clerical positions in the freight and telegraph departments, was appointed superintendent of telegraphs on Sept. 1, 1893. His jurisdiction was extended over the entire Burlington system on May 1, 1900. On Jan. 1, 1910, he was appointed general superintendent of telegraphs on the New York Central system west of Buffalo, and on Oct. 1, 1912, he was appointed manager of the railway department of the Western Union Telegraph Company.

W. W. Ryder

Mr. Gerard Swope, general sales manager of the Western Electric Company, has been nominated by the Alumni Association of the Massachusetts Institute of Technology as a term member in the corporation of the Massachusetts Institute to serve five years. Mr. Swope, who was graduated with the class of 1895, entered the employ of the Western Electric Company at Chicago in that year. He spent a year in various departments of the shops and in 1896 entered the power apparatus engineering department as designing engineer. He organized and was the first manager of the St. Louis house, opened in January, 1901, and at the beginning of 1906 was transferred to Chicago as power apparatus manager, in charge of the sales, manufacturing and engineering of the power apparatus business of the company. In 1908 Mr. Swope became general sales manager with headquarters at New York, in charge of all branches of the company's commercial work in the United States and foreign countries. He was elected vice-president in January, 1913. Mr. Swope is a member of the Engineers', Railroad, City, Technology and Economic clubs of New York, the Union League Club of Chicago, the American Economic Association, the Society for Electrical Development, the American Institute of Electrical Engineers, the American Statistical Association, the National Electric Light Association. the American Academy of Political and Social Science, the National Society for the Promotion of Industrial Education. the Rutgers Club of New Brunswick, N. J., and the Electrical Manufacturers' Club.

Construction

New England

SEARSPORT, MAINE. — Negotiations have been closed whereby the property of the Searsport El. Co. will be taken over by the Penobscot Bay El. Co., of Bucksport. The local power plant will be operated until it can be connected with the trunk line of the Penobscot company, which extends from the power plant at Toddy Pond to Belfast and runs within about one-half mile of the town limits. A. C. Hopkins, of Belfast, is local manager.

WATERVILLE, MAINE.—A movement has been started in the towns of Ripley, Exeter and Garland to secure the extension of the transmission lines of the Central Maine Pwr. Co., of Waterville, to those towns; a similar movement has also been started in Silvers Mills. Six miles of line would have to be erected to reach Ripley and 12 miles of new line would be necessary to connect Exeter and Garland with the system.

HARRISVILLE, R. I.—The Blackstone Valley Gas & El. Co., of Woonsocket, has submitted a proposition to the Harrisville fire district offering to furnish electricity for lighting the streets of the village at $27 per lamp per year; also to furnish energy for commercial lighting.

HARTFORD, CONN. — The Board of Contract and Supply has awarded the contract for erecting 141 double-lamp posts and 113 single-lamp posts and furnishing all fixtures, and electricity for maintaining same, until June 1, 1918, to the Hartford El. Lt. Co., as follows: For 141 double lamps, at $11,280; 113 single lamps, $6,215, making a total of $17,495.

Middle Atlantic

ELMIRA, N. Y.—The Public Service Commission has granted the Elmira Transmission Corpn. permission to erect high-tension transmission lines from the Riverside power plant through the towns of Horseheads and Big Flats in Chemung County, and in Corning in Steuben County. The company already has secured franchises from these towns.

FORESTPORT, N. Y.—A 24-in. S. Morgan Smith vertical waterwheel, with steel case, operating under a 10-ft. head, and steel flume 4 ft. in diameter, 68 ft. long, concrete dam and forebay, has been recently installed in the local electric-light plant, owned by George Farley. The wheel is regulated by a Sturgess waterwheel governor, manufactured by the Ludlow Valve Mfg. Co., of Troy, N. Y.

TONAWANDA, N. Y.—The City Council is considering the question of installing a new street-lighting system in the business district. The Tonawanda Pwr. Co., of North Tonawanda, furnishes the street-lighting service here. Frank M. Gordon is manager.

BANGOR, PA.—The Town Council has granted the Industrial El. Lt. Co. a franchise to construct and operate an electric-light system in this borough.

HUNTINGDON, PA.—Bids will be received by the Board of Education of the Huntingdon Borough School District until Jan. 14 for the erection of a 12-room school building in the Fourth Ward. Separate bids will be received for construction of building, heating and ventilating, plumbing, electrical work and seating. Plans and specifications may be obtained from G. G. Harman, secretary of board, or J. Herbert Hall, architect.

MARCUS HOOK, PA.—Arrangements have been completed by the Beacon Lt. Co., of Chester, which recently erected a substation here, for furnishing electricity to the American Viscose Co., besides furnishing energy for lighting the streets of the borough and for private residences. The company proposes to extend its distributing lines to the suburbs of Marcus Hook as soon as possible.

MILFORD, PA.—The Shohola Falls Hydro-Electric Co., of Milford, has filed a notice of increase in capital stock from $6,000 to $4,500,000. The company proposes to develop the water-power of the Delaware River at Belvidere and at other points. The company has already purchased considerable land where it expects to erect dams and power stations.

PHILADELPHIA, PA.—The Pennsylvania R. R. Co. has entered into a contract with the Philadelphia El. Co. for electricity to operate its suburban electric-car service between Paoli and Chestnut Hill for a period of five years. Energy will be supplied from the main station at Christian Street Wharf, Schuylkill River. The Pennsylvania R. R. Co. will erect a substation on the opposite side of the river and the power company will carry its lines across the river. The contract calls for 3150 kw, with a load-factor of 25 per cent use of said energy.

READING, PA.—The Reading Transit & Light Co. has given notice of its intention to apply for authority to increase its indebtedness from $750,000 to $50,000,000. The proposed increase will be used to provide funds to extend its operations.

SUSQUEHANNA, PA.—The contract for construction of the building for the new electric plant for the Susquehanna Electric Construction Co. has been awarded to Williams & Richardson, of Scranton. The building will be 130 ft. long and 38 ft. wide, one story high, and will cost about $9,000.

WASHINGTON, PA. — The Borough Council has granted the Relief El. Lt., Ht. & Pwr. Co. a franchise to construct and operate an electric-light plant in Washington.

WASHINGTON, PA.—The Relief El. Lt., Ht. & Pwr. Co. has applied to the Council of East Washington for a franchise to furnish electricity for lamps and motors in that town. Robert R. Reed is manager.

BALTIMORE, MD.—The installation of a new electric emergency signal system for the Police Department is under consideration.

LONACONING, MD.—It is reported that the Home El. Lt. Co., of Lonaconing, is planning to remove the equipment from its plant to the plant of the Lonaconing El. Lt. & Pwr. Co.

MANASSAS, VA.—The contract for construction of the proposed municipal electric plant has been awarded to Sterrett & Fleming, Evans Building, Washington, D. C. C. R. C. Johnson is chairman, and N. Wilson Davis is engineer.

WASHINGTON, D. C.—Bids will be received at the office of the electrical engineer in charge of automatic scales, Treasury Department, Washington, until Feb. 11, for furnishing and installing, complete, automatic weighing and recording scales. For details see proposals columns. C. S. Hamlin is assistant secretary.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 31 for construction of two steel towers and concrete foundations at the navy yard, Washington, D. C. Plans and specifications may be obtained on application to the bureau or to the commandant of the navy yard named. The cost of the work is estimated at $12,000. H. R. Stanford is chief of bureau.

North Central

FLUSHING, MICH.—The plant of the Hart Milling & Pwr. Co. was completed and placed in operation Dec. 1, 1913.

GRAND RAPIDS, MICH. — Governor Ferris has signed the water-power amendment to the city charter, which provides for obtaining the water-power rights in the Grand River either by purchase or condemnation, and this amendment will be submitted to the voters at the spring election. The city may then either preserve the water-power rights or destroy the dams for flood protection. A bond issue of $450,000 to pay for the river rights must also pass to make the charter amendment effective.

HASTINGS, MICH.—The Thornapple Gas & El. Co., of Hastings, has completed the installation of an electric distribution plant in Caledonia and is now furnishing electrical service there. L. W. Heath is manager.

MACKINAC ISLAND, MICH.—The Municipal Wtr., Lt. & Pwr. Co., of Mackinac Island, has purchased a 200-kw generator and two switchboards from the General Electric Co. Orders have been placed with the Allis-Chalmers Co. for a 200-kw directly connected generating unit, consisting of an engine and generator (60 cycles, 2300 volts, 150 r.p.m.), to be delivered Feb. 1, 1914. A. T. Doherty is secretary.

MUNISING, MICH. — Preparations are being made by the Munising Paper Co., it is reported, to install a 400-kw generator and a 650-hp engine in its power plant.

NORTHVILLE, MICH.—The Board of Public Works has recently completed a water-power plant (about 50 hp) to be operated in connection with the municipal steam-driven station. Samuel Wilkinson is superintendent.

WAKEFIELD, MICH.—Bids will be received by John Avery, clerk, until Jan. 10 for furnishing material and construction of substation; also for furnishing and installing all material and equipment for overhead distributing system, including switchboard, instruments and meters. Plans and specifications may be seen at the office of the clerk, or at the office of Charles Smeeth, engineer, Ironwood, Mich. Complete sets of plans may be obtained upon application to J. W. Bedell, president of the village, or from the clerk, for which a deposit of $5 will be required, to be refunded upon return of plans.

ALLIANCE, OHIO.—The City Council has killed the ordinance providing for the sale of $15,000 in bonds by the people for a municipal electric-light plant and at the same time voted down a measure to enter into a new contract with the local Alliance Gas & Pwr. Co.

CANAL DOVER, OHIO.—Application has been made to the State Utilities Commission by the County El. Co., operating in Canal Dover, New Philadelphia, Uhrichsville and Dennison; the Twin City Trac. Co., operating a street-car service between Uhrichsville and Dennison; the Midland Pwr. & Htg. Co., of Cambridge, operating an electric railway between Cambridge and Byesville; the Newcomerstown El. Lt., Ht. & Pwr. Co., of Newcomerstown; the Coshocton Lt. & Htg. Co., of Coshocton, and the Lafayette Lt. & Pwr. Co., of Lafayette, to consolidate under the name of the Ohio Service Co., to be capitalized at $1,000,000. These properties are owned by the Brooks interests, of Scranton, Pa., which are now building a large power plant at Coshocton.

CANTON, OHIO.—Preliminary plans are being prepared by the United Engineering & Construction Co., Schofield Building, Cleveland, for the proposed municipal electric-light plant. The cost of the plant is estimated at $70,000. Ray Herbert is director of public service.

CLEVELAND, OHIO.—Bids will be received by W. H. Kirby, secretary to the director of public service, No. 204 City Hall, Cleveland, until Jan. 14, for piping for the municipal electric-light plant. Plans and specifications may be obtained in the office of the engineer of construction, Room 419, City Hall, Cleveland. W. J. Springborn is director of public service.

CUYAHOGA FALLS, OHIO.—Plans are being considered by the Board of Public Affairs for improvements to the municipal electric-light plant. New boiler equipment will soon be needed as well as new piping and transmission apparatus.

DEFIANCE, OHIO.—The light committee of the City Council has submitted an estimate for the installation of cluster lamps in the business district to replace the arc lamps now in use.

McCOMB, OHIO.—A 150-hp Brownell tubular boiler is now being installed in the municipal electric-light plant. A. Keel is clerk of Board of Public Affairs.

MINERAL CITY, OHIO.—The Federal Clay Product Co., of Mineral City, is contemplating the installation of a 1000-hp electric power plant and is asking for prices on different appliances for same. Water-tube boilers with superheaters will probably be used. The installation of three engines of 450 hp, 300 hp and 150 hp respectively is under consideration. These may be compound condensing, or a turbine may be used for the largest unit and simple engines used for the smallest units. The engines are to be directly connected to alternating-current generators, of 300 kw, 200 kw and 100 kw respectively (60 cycles, three-phase, 440 volts). The company also expects to purchase some motors. In the issue of Dec. 20, under Canton, Ohio, the company was reported to be contemplating the construction of a new building and installation of a 1000-hp power plant.

WEST MILTON, OHIO.—L. A. Pearson, owner of the local electric-light plant, has recently completed a 5-mile extension to the town of Phillipsburg. Further extensions will probably be made in the spring.

WILMINGTON, OHIO.—The Ohio Public Utilities Commission has authorized the Dayton Pwr. & Lt. Co., of Dayton, to issue $125,000 in bonds and $50,000 in capital stock, the proceeds to be used to purchase the property of the Wilmington Wtr. & Lt. Co.

WOOSTER, OHIO.—The Wooster El. Co. is now installing a 250-kw Allis-Chalmers generator and engine (directly connected), with all necessary equipment.

YOUNGSTOWN, OHIO. — Plans have been completed by the Mahoning & Shenango Ry. & Lt. Co. for extensions to its system in connection with the large power plant recently erected in Lowellville, involving an expenditure of about $250,000. The plans provide for increasing the output of the Lowellville plant by 10,000 hp; also for doubling the transmission lines all through the valley. Youngstown, Sharon and New Castle will all be connected with high-tension transmission lines. R. P. Stevens is president of the company.

ERLANGER, KY.—Arrangements are being made by the Union Ht., Pwr. & Lt. Co., of Covington, to furnish electrical service in Erlanger, a suburb of Covington.

HARDIN, KY.—The installation of an electric-light plant in Hardin is reported to be under consideration. A. L. Griffin & Son are reported to be interested in the project.

HARLAN, KY.—The Kentucky Utilities Co., of Lexington, has acquired the local electric plant. The plant, it is understood, will be enlarged to enable it to furnish electricity to the neighboring coal fields.

HAZARD, KY.—The Hinyar Coal Corpn., it is reported, would like to receive prices on a 150-kw, 250-volt generator and engine (directly connected) and switchboard complete. J. B. Allen, of Hazard, is manager.

MORGANFIELD, KY.—The Morganfield Lt. & Pwr. Co. is now erecting a new power house (50 ft. by 90 ft.), with brick and concrete chimney. Equipment for the station has already been purchased.

CLINTON, IND.—The Clinton El. Lt. & Pwr. Co. has recently completed the installation of two 252-hp Stirling boilers. C. M. Poor is superintendent.

HUNTINGTON, IND.—Within the next few months the city of Huntington expects to build an entire new power house for the municipal electric-light plant; also to purchase two electric generating units of about 500 kw each. It is not yet decided whether turbines or reciprocating engines will be used. The new plant will furnish electricity to operate the city water-works station, as well as for street-lighting and for commercial purposes. J. W. Hier is superintendent.

INDIANAPOLIS, IND.—The Merchants' Ht. & Lt. Co., of Indianapolis, expects to erect an addition to its No. 2 plant at West Washington Street and the river within the next six months; also to purchase within the next four months one 10,000-kva turbo-generator set. E. Darrow is general manager.

ALTON, ILL.—The Alton Gas & El. Co. has increased its capital stock from $500,000 to $550,000.

ASHLAND, ILL.—Two proposals have been submitted by Abbott Brothers, of Petersburg, to the Village Board for lighting the streets of the village. One is to extend their transmission lines from Tallula to Ashland, and the other to lease the municipal electric-light plant.

ASTORIA, ILL.—The Central Illinois Public Service Co., of Mattoon, is erecting a transmission line to the Big Lake drainage district. Electricity will also be supplied to the Peter Hamm drainage district south of Sheldon's Grove.

AVON, ILL.—Application has been made to the Village Board by E. R. Kennedy, of Oneida, for a franchise to operate an electrical distribution system in Avon.

AVON, ILL.—The Avon Milling & Mfg. Co., of Avon, has applied to the Village Board for a new franchise. Owing to a technicality the company has surrendered its old franchise and is seeking a new one.

BUDA, ILL.—The Kewanee Lt. & Pwr. Co., of Kewanee, has applied to the Village Board for a 20-year franchise to operate an electric-lighting system in Buda.

BUDA, ILL.—Application has been made to the Village Board by the Spring Valley Gas & El. Co., of Spring Valley, for a franchise to install and operate an electric-light system in Buda for a period of 50 years. The company also asks for a 20-year franchise to light the streets of the village.

COLUMBIA, ILL.—Within the next 12 months the village of Columbia expects to purchase a new engine and a car load of poles for the municipal electric-lighting system. E. L. Rauch is superintendent.

DALLAS CITY, ILL.—The Dallas City Lt. Co. has increased its capital stock from $30,000 to $60,000.

DECATUR, ILL.—The Decatur Ry. & Lt. Co. within the next 12 months expects to install an underground distribution system and to purchase general distribution supplies and electrical utensils, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. William C. Peplon is superintendent.

ELGIN, ILL.—The city commissioners, it is reported, have decided to ask separate bids on various types of material connected with the municipal electric-light plant, instead of letting a general contract. Work on the proposed plant will probably start in April. C. A. Chapman is engineer.

KNOXVILLE, ILL.—The City Council has awarded the Western Rys. & Lt. Co., of Champaign (controlled by the McKinley interests), a contract to light the streets of the city and also to furnish electricity for operating the pumping station of the municipal water-works system. Energy will be supplied from the central station at Galesburg.

LEBANON, ILL.—The Southern Illinois Lt. & Pwr. Co., of Hillsboro, has submitted a proposal to the Town Council offering to lease the municipal electric-light plant for a period of 20 years.

LE ROY, ILL.—The capital stock of the Leroy El. Lt., Pwr. & Htg. Co. has been increased from $10,000 to $40,000. The proceeds will be used for extensions to its system. As yet no definite plans have been made.

LINCOLN, ILL.—Within the next two months the Lincoln Wtr. & Lt. Co. expects to purchase some wiring supplies. The company may also purchase a few iron poles. E. MacDonald is superintendent.

MATTOON, ILL.—The City Council has passed a resolution authorizing the consolidation of the electric-light and water plants. New machinery will probably be required for the electric-light plant as the Council contemplates furnishing electricity for the proposed ornamental street-lighting systems.

MELVIN, ILL.—The Central Illinois Utilities Co., of Paxton, has applied for a 30-year franchise to construct and operate an electric-lighting system in Melvin. If granted, the company will erect a transmission line from Elliott.

NASHVILLE, ILL.—The Nashville El. Lt. Co. has increased its capital stock from $15,000 to $80,000. The company has also applied to the Village Board of Hoyleton, Ill., for a franchise to furnish electricity in that village. If granted, the company will erect 12 miles of high-tension transmission line. A number of other small towns will be supplied with electrical service if the line is built. K. A. Steinhauser is secretary and manager.

NEPONSET, ILL.—The Kewanee Lt. & Pwr. Co., of Kewanee, has applied to the Village Board for a 20-year franchise to furnish electricity for lamps and motors in Neponset.

OTTAWA, ILL.—The merchants who contemplate the installation of ornamental lamps have asked the City Council to pass an ordinance compelling a uniform style of posts.

PAXTON, ILL.—The Central Illinois Utilities Co., of Paxton, has increased its capital stock from $700,000 to $1,000,000.

PECATONICA, ILL.—The Pecatonica El. Lt. Co. expects to erect within the next five months a new power house and to purchase one 100-hp to 125-hp boiler, one 100-hp engine and one alternating-current, 60-cycle generator, 50 kva in transformers, one regulator transformer for either alternating-current arc lamps or incandescent lamps for street lighting. The company contemplates changing its system from 133 cycles to 60 cycles. A. W. Waterstreet is manager.

PETERSBURG, ILL.—The Abbott Lt. & Pwr. Co., of Petersburg, recently incorporated, has taken over the Petersburg electric-light plant, owned by Abbott Brothers. The new company is capitalized at $300,000. Improvements are contemplated by the company, including the erection of 6 miles of 16,500-volt transmission line. Within the next three months the company expects to purchase two single-pole switches and arrester for 16,500 volts, two 75-kw, 16,500/1100/2200-volt transformers and ten 15-kw and 5-kw, 2200/110/220-volt transformers. R. H. Abbott is president.

QUINCY, ILL.—The City Council will ask for bids for lighting the streets of the city.

SHERRARD, ILL.—Within the next three months D. W. Bowen, owner of the local electric-light plant, expects to purchase a 50-kw to 75-kw, double-current generator (220 volts, direct current, and 60-cycle, alternating-current), second-hand, or a 50-kw to 75-kw, 2200-volt or 220-volt, three-phase, 60-cycle alternating-current generator.

SIDNEY, ILL.—The Village Board has granted a franchise to U. G. S. Thompson to operate an electric-lighting system in Sidney; also a contract for lighting the streets of the village.

STERLING, ILL.—Plans have been approved by the City Council and a committee from the Commercial Club for the installation of an ornamental street-lighting system providing for 82 lamp standards.

STERLING, ILL.—A committee has been appointed by the consumers of electricity for power purposes to investigate the cost of the erection and the maintenance of a co-operative electric plant. Peter Franz and E. C. Cochran are members of the committee.

THAWVILLE, ILL.—The Central Illinois Utilities Co., of Paxton, has applied for a franchise to install and operate an electrical distributing system in Thawville.

WAUKEGAN, ILL.—The installation of an ornamental street-lighting system on Genesee and Washington Streets is under consideration.

EAU CLAIRE, WIS.—Surveys are being made for the construction of a new dam and hydroelectric plant on the Chippewa River at Paint Creek for the Chippewa Valley Ry., Lt. & Pwr. Co.

MILWAUKEE, WIS.—Provisions for a $100,000 bond issue for a municipal electric-light plant have been included in the 1914 budget by the board of estimates.

DENISON, IA.—The City Council has decided to call an election to submit the proposal to issue $65,000 in bonds, the proceeds to be used to purchase the local electric-light plant and to extend and improve the same.

MINDEN, IA.—The installation of a municipal electric-light plant in Minden is under consideration.

JEFFERSON CITY, MO.—The capital stock of the Jefferson City Lt., Ht. & Pwr. Co. has been increased from $200,000 to $400,000.

JEFFERSON CITY, MO.—The City Council has refused to call an election to vote on the proposal to issue $150,000 in bonds to establish a municipal electric-light plant.

MARSHALL, MO.—At an election held Dec. 18 the proposal to issue $70,000 for the installation of a municipal electric-light plant was defeated the second time.

ST. CHARLES, MO.—Within the next 12 months the American Lt. & Pwr. Co., of St. Charles, expects to purchase a miscellaneous supply of insulators, wire and meters; also heating and cooking apparatus, washing machines, supplies and switches. H. I. Ward is manager.

WARWICK, N. D.—Steps have been taken by the Western Utilities Corpn., of Devils Lake, to establish an electric light, power and heating system in Warwick. F. E. Corson is president and general manager.

GARDEN CITY, KAN.—The construction of a large central power plant in Garden City to furnish electricity to operate pumping plants for irrigation purposes is contemplated by the United States Sugar & Land Co., which is being reorganized under the name of the Garden City Sugar & Land Co. The company proposes to utilize the underground flow of water that exists in this neighborhood. The directors of the new company are: C. M. MacNeill, Spencer Penrose, J. Addison Hayes, C. A. Sheetz and H. A. Jones.

Southern States

DURHAM, N. C.—The Durham Trac. Co. is now installing two 350-hp Stirling Boilers. R. S. Lindsey is general manager.

HENDERSONVILLE, N. C.—The Hendersonville Pwr. & Lt. Co. is contemplating the construction of a dam across the Big Hungry River to develop 200 hp, which will be used as an auxiliary to its present plant near by.

ALLENDALE, S. C.—Plans, it is reported, have been prepared by the J. B. McCrary Co., of Atlanta, Ga., for the installation of a municipal electric-light plant and water-works system in Allendale, to cost about $25,000.

WOODRUFF, S. C.—The Town Council has decided to change the street-lighting system from arc lamps to tungsten series street lamps. The contract has been awarded to the South Carolina Lt., Pwr. & Rys. Co., of Spartanburg, which furnishes electrical service here. J. E. Ezell is clerk.

GEORGETOWN, GA.—The City Council is reported to be considering the installation of an electric-lighting system here. The Council, it is said, has applied to the City Council of Eufaula, Ala., to furnish electricity from the municipal electric plant to operate an electric system in Georgetown.

LEESBURG, GA.—The City Council, it is reported, has engaged the J. B. McCrary Co., of Atlanta, Ga., to prepare plans for an electric-light plant, to cost about $10,000.

VILLA RICA, GA.—The Villa Rica El. Lt. & Pwr. Co. is contemplating the purchase of an electric generating unit of about 50 kva, 2300 volts (directly connected), with transformers. W. B. Powell is general manager.

CHIPLEY, FLA.—The Chipley Lt. & Pwr. Co. within the next three months expects to erect a 10-ton ice plant to be operated in connection with its water and light plant; also to purchase one 50-kva, 60-cycle, 2300-volt revolving-field alternator with steam engine.

GRACEVILLE, FLA.—Within the next three months the managers of the municipal electric-light plant expect to purchase about three dozen meters for residents and business places. Charles T. Atkinson is superintendent.

JACKSONVILLE, FLA.—Bids will be received by the trustees for the water-works and improvement bonds of the city of Jacksonville until Jan. 15 for furnishing certain items of lead-covered underground electrical cables in accordance with plans and specifications on file in the office of the chief of the Fire Department, Jacksonville, these specifications covering rubber insulation. Frank Richardson is chairman.

TALLAHASSEE, FLA.—The Everglades Engineering Commission on the drainage of the Florida Everglades has submitted its report to the trustees of the internal improvement fund. In the report it states that a water-power can be developed of 5000 electric hp, and recommends that this be done.

NASHVILLE, TENN. — Arrangements are being made by the Nashville Ry. & Lt. Co. for the construction of 30 miles of new street lines about Feb. 1. Manufacturers of cars, steel rails, motors, copper wire and cross-ties have been notified to submit bids to the board of directors for same. The Detroit & Nashville Construction Co. has been organized for the purpose of doing construction work for the company.

NASHVILLE, TENN.—Only one bid was received Dec. 11 for a franchise (100 years) for the water-power development at Muscle Shoals, Ala., on the Tennessee River. This bid was submitted by the Muscle Shoals Hydro-Electric Pwr. Co. and provides for three classes of payments as follows: (1) For payment of $3,000,000 in cash on completion of locks, dams and substructures of power houses; (2) yearly payments of $75,000 at the end of the first year, $125,000 at the end of the second year, $150,000 at the end of the third year, $175,000 at the end of the fourth year, $200,000 at the end of the fifth year, and $240,000 each year thereafter; (3) payment on installation of 30 cents per year for each horse-power of installed capacity shown on switchboard, the payments not to begin until the installed capacity reaches 200,000 hp, but in any event to begin at the end of 20 years. This bid is a modification of the plans of the board, eliminating the intermediate lock and dam and increasing the height of dam No. 2 of the board's plans. The bid received June 24 from C. E. Jones, of Chattanooga, is still before the board. This bid is for $6,250,000 cash contribution upon the completion of the locks, dams and substructure of power houses, in accordance with plans of the board.

HOPE, ARK.—Within the next year the managers of the municipal electric-light plant expect to purchase one boiler. Charles M. Richards is superintendent.

WILMOT, ARK.—Messrs. Maingault & Graham, it is reported, have been granted a franchise by the City Council to install and operate an electric-light plant to furnish electricity for lighting a block of stores in Wilmot.

LOGANSPORT, LA.—The Commercial Club, it is reported, is negotiating with P. W. McKitrick, of Timpson, Tex., to construct an electric-light plant, ice factory and bottling works in Logansport.

AFTON, OKLA.—Plans have been under consideration by the city of Afton whereby arrangements may be made to furnish electricity from the municipal electric-light plant in the town of Fairland. It is proposed to erect a 16,000-volt transmission line to Fairland (the expense to be borne by that town) at a cost of about $5,000, which would provide for transformers in Fairland.

BROWNWOOD, TEX.—The City Council is considering the question of installing electric equipment at the water-works plant.

CORPUS CHRISTI, TEX.—The City Council has awarded the Corpus El. Ice & El. Co. a contract to install a complete new street-lighting system. Under the terms of the contract the system must be in operation by May 1.

CUERO, TEX.—The Cuero Lt. & Pwr. Co. has been granted a 50-year franchise in Cuero, under the terms of which the company will replace the present 40-cp street lamps with lamps of 80 cp. The company contemplates the construction of another dam near here to increase the output of its system.

MARSHALL, TEX.—The Marshall El. Co. will install a 500-kw steam turbo-generator set, one 200-kw railway rotary converter and static transformer, one 25-kw motor-generator, switchboard panels, instruments for existing panels and two 400-hp boilers. Equipment has already been purchased. E. L. Wells, Jr., is vice-president and manager.

SEGUIN, TEX.—The Council has decided to call an election to submit the proposal to issue $20,000 in bonds to the voters. Of the proceeds $12,500 will be used for improvements and extensions to the municipal water and light plants, and $7,500 for payment of water-works bonds.

YORKTOWN, TEX.—The property of the Yorktown Lt. & Ice. Co. has been purchased by E. A. Clousnitzer, who, it is said, will make extensive improvements to the electric plant and extend the lighting system.

Pacific States

ABERDEEN, WASH.—The City Council is contemplating calling a special election in the near future to submit the proposal of issuing bonds for the installation of a municipal electric-light plant and water-works system to the voters.

SEATTLE, WASH.—The stockholders of the Puget Sound Trac., Lt. & Pwr. Co., of Seattle, have voted to authorize $7,500,000 in notes or short-term bonds, the proceeds to be used for refunding purposes and to provide funds for extensions and improvements.

SEATTLE, WASH.—The City Council has decided to submit to the voters the proposal to issue $250,000 in bonds for the condemnation of the Lake Cushman power site, owned by Joseph E. Wickstrom, to be utilized for the construction of an auxiliary power plant for the municipal lighting system.

SEATTLE, WASH.—The Board of County Commissioners has granted the Puget Sound Trac., Lt. & Pwr. Co., of Seattle, a franchise to erect a transmission line through the southern part of the county to furnish electricity in Kent, Auburn and other communities in the White River Valley.

SPOKANE, WASH.—The City Council is considering the installation of an electric plant in the municipal building.

SPOKANE, WASH.—The contract for wiring the union depot in Spokane for the Oregon-Washington R. R. & Navigation Co. and the Chicago, Milwaukee & St. Paul R. R. Co. has been awarded to Nepage, McKenna & Co., of Seattle, electrical contractors, for $10,000.

TACOMA, WASH.—The City Council has authorized the installation of luminous-arc lamps in the business district, to cost about $36,000.

TACOMA, WASH.—Bids will be received by A. U. Mills, commissioner of public safety, City Hall, Tacoma, until Jan. 15, for furnishing one motor-driven pumping engine, having a capacity of 1000 gal. per minute at 130 lb. pressure; one motor-driven chemical and hose wagon with a capacity of 1000 ft. of 2½-in. hose, and a 40-gal. or 50-gal. chemical tank and reel for 200 ft. of 1-in. chemical hose.

TENINO, WASH.—We are informed that the Northwest El. & Water Wks. Co., of Seattle, has purchased only the Tenino water-works. The lighting plant is owned and operated by the Washington-Oregon Corpn., 1311 Yeon Building, Portland, energy being supplied from its steam-generating plant at Chehalis. An item was published in the issue of Nov. 22 stating that the local electric-light plant has been purchased by the Northwest company. F. L. Stokes is local manager of the Washington-Oregon Corpn.

AZUSA, CAL.—Within the next six months the entire municipal electric-light system will be rebuilt to comply with the State law. Material, costing about $20,000, for distribution system will be required. A new series street-lighting system will be installed. Hardin W. Thompson is superintendent.

SAN BERNARDINO, CAL.—The Pacific El. Ry. Co., it is stated, will soon begin work on the erection of a substation (to cost $15,000) to be located near the junction in San Bernardino of the Pacific electric lines between Los Angeles, Riverside and adjacent cities. Paul Shoup is president and George E. Pillsbury is chief engineer, both of Los Angeles.

SAN FRANCISCO, CAL.—The Northern California Pwr. Co., 995 Market Street, San Francisco, expects to purchase within the next six months material for 50 miles of transmission lines and 1000 kw in line transformers. E. V. D. Johnson is manager.

FORT HUACHUCA, ARIZ.—Bids will be received at the office of the constructing quartermaster, Fort Huachuca, Ariz., until Jan. 9 for furnishing materials and constructing, complete, one double set of captain's quarters, including plumbing and electric wiring and a double blacksmith shop at this post. Plans and specifications may be obtained upon application to E. S. Walton, constructing quartermaster, for which a deposit of $10 will be required, to be refunded upon return of plans.

TUCSON, ARIZ.—A company has been organized under the name of the Arizona Pwr. & Wtr. Co. to utilize the waters in the Sabadia Canyon in the Rincon Mountains for power and irrigation purposes. It is proposed to build a large dam in the canyon, for which a permit has been obtained from the forest service. The company is capitalized at $5,000,000. Parties connected with the Cababi Mining Co. are interested in the project. S. G. McWade is manager of the Arizona Pwr. & Wtr. Co.

DENVER, COL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 16 for mechanical equipment (except roof drainage and elevators) of the United States post office at Denver, Col. For details see proposal columns. O. Wenderoth is supervising architect.

Canada

CALGARY, ALTA.—The City Council has approved a recommendation of the City Commissioners providing for an agreement with the Bowness Estates Co., of Calgary, to furnish electricity to operate the Bowness line of street cars for a period of three years at 2 cents per kw-hr.

NEW WESTMINSTER, B. C.—The Pacific Great Eastern Development Co. has applied for permission to use water rights of the Squawmish River for power purposes. Application has also been made by A. M. Davis, of Victoria, for permission to use the waters of Summit and Eight Mile Creek for power development.

PRINCETON, B. C.—Tenders have been called by the Princeton Coal & Land Co. for electrical equipment, which, it is understood, will provide for generating electricity for distribution for lamps and motors in Princeton.

WINNIPEG, MAN.—At an election held recently the proposal to issue $1,000,000 in bonds for extensions to the municipal light and power system was carried. J. G. Glassco is manager of the city Light and Power Department.

WINNIPEG, MAN.—Tenders will be received by the city of Winnipeg until Jan. 5 for furnishing pole-type and subway transformers required during the year 1914. Plans and specifications may be obtained from the office of the City Light and Power Department, 54 King Street, Winnipeg. M. Peterson is secretary of Board of Control.

AMHERST, N. S.—Negotiations are under way between the Canada El. Co., of Amherst, and the Town Council relative to the improvement of the street-lighting system.

COURTRIGHT, ONT.—A proposal has been submitted by a private party to the Town Council for the installation of a gasoline-driven electric plant to furnish electricity for lighting the town. The installation of a municipally owned plant has also been suggested.

HAVELOCK, ONT.—At the coming municipal election the by-law to authorize the Council to enter into a contract with the Hydro-Electric Power Commission for electricity will be submitted to the ratepayers.

ST. THOMAS, ONT.—The City Council is contemplating the installation of an ornamental street-lighting system on the main streets of the city.

WYOMING, ONT.—The installation of an electric-lighting system in Wyoming is under consideration.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Jan. 13, for panelboard and boxes, electric cable, conduit and fittings, and miscellaneous electrical apparatus, electric detonators, prismatic lamps and lumber. Blanks and general information relating to this circular (No. 817) may be obtained from the above office, or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Incorporations

DOVER, DEL.—The Hovey El. Ser. Co. has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 for the purpose of generating and distributing electricity for lamps, heaters and motors. The incorporators are A. C. Hovey, B. C. Tunison and C. J. Winkler, of Pittsburgh, Pa.

BOWLING GREEN, FLA.—The Bowling Green El., Wtr. & Pwr. Co. has been incorporated with a capital stock of $300,000. C. E. Auld is president.

PETERSBURG, ILL.—The Abbott Lt. & Pwr. Co. has been granted a charter with a capital stock of $300,000 to operate a light, heat and power plant. The incorporators are R. H. Abbott, I. B. Abbott and A. E. Abbott.

SKOWHEGAN, MAINE.—The Skowhegan El. Co. has been incorporated with a capital stock of $200,000 to generate and distribute electricity, etc. H. L. Sweet, of Skowhegan, is president, and F. W. Briggs, of Pittsfield, is treasurer and clerk.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, H. O. Hanson, Mobile Gas Co., Mobile, Ala. Semi-annual meeting, Mobile, Ala., May, 1914.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary-treasurer, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary, Eugene W. Stern, 101 Park Ave., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Secretary, William H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, Edwin A. Scott, 29 West 39th St., New York.

AMERICAN WATER WORKS ASSOCIATION. Secretary, J. M. Diven, 47 State St., Troy, N. Y. Annual meeting, May.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, May.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Geo. C. Holberton, Pacific Gas & Electric Co., San Francisco, Cal.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, W. T. Snyder, McKeesport, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago. Annual meeting, New Orleans, May 19-22.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. S. Hanbridge, 1408 Merchants' National Bank Building, Los Angeles, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary-treasurer, J. H. Larmonth, 610 Confederation Life Bldg., Toronto, Can.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Col.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

ELECTRIC CLUB OF CHICAGO. Secretary, Fred M. Rosseland, Monadnock Block, Chicago. Meets every Thursday noon at Hotel Sherman.

ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER BOSTON. Secretary, R. S. Hale, 39 Boylston St., Boston.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, H. D. Temple, 30 Foster St., Worcester, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF THE CITY OF CHICAGO. Secretary, M. N. Blumenthal, 179 West Washington St. Meets at noon on the second and fourth Wednesday of each month at 424 South Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Peterman, 626 Lloyd St., Milwaukee, Wis.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary, John W. Crum, 1324 Land Title Building, Philadelphia, Pa.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA, NEW ENGLAND SECTION. Secretary, L. L. Edgar, 39 Boylston St., Boston.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FARADAY ELECTRICAL ASSOCIATION. Secretary, W. J. Collins, 1129 Masonic Temple, Chicago. Meets at noon on the first and third Wednesday of each month at Planters' Hotel.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla. Annual meeting, May, 1914.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, J. D. Israel, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia, Chicago and Pittsburgh.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA. Secretary, W. S. Vivian, Grand Rapids, Mich.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INSTITUTE OF OPERATING ENGINEERS. Secretary, L. Houmiller, 29 West 39th St., New York.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 81 New St., New York.

INTERNAL-COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 West Indiana St., Chicago. Meeting second Friday of each month at Lewis Institute.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTRICAL CONGRESS. Secretary, Dr. E. B. Rosa, Bureau of Standards, Washington, D. C. San Francisco, Sept. 13-18, 1915.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Congress, San Francisco, September, 1915.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster. London, S. W., England. Meeting at San Francisco, Sept. 6-11, 1915.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary, H. B. Maynard, Waterloo, Ia.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, Cedar Rapids, April 23, 1914.

JOVIAN ORDER. Jupiter (president), W. N. Matthews, St. Louis, Mo.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary-treasurer, Ivor Thomas, 237 South Main St., Wichita, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. J. Ziegler, 227 Bourbon St. Meeting every Wednesday, Audubon Building, New Orleans.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Waterville, Maine.

MINNESOTA ELECTRIC ASSOCIATION. Secretary-treasurer, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn. Annual meeting, Minneapolis, March, 1914.

MISSISSIPPI ELECTRIC ASSOCIATION (affiliated with the National Electric Light Association). Secretary-treasurer, Frank J. Duffy, Natchez, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATER WORKS ASSOCIATION. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis. Annual meeting, May.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, Philadelphia, May, 1914.

NATIONAL ELECTRIC LIGHT ASSOCIATION, COMMERCIAL SECTION. Secretary, J. F. Becker, 1170 Broadway, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION, EASTERN NEW YORK SECTION. Secretary, C. S. Van Dyck, Schenectady, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION, HYDROELECTRIC SECTION. Secretary, S. A. Sewall, 29 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MICHIGAN SECTION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NORTHWEST SECTION. Secretary, N. W. Brockett, Pioneer Building, Seattle, Wash.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PUBLIC SERVICE SECTION. Secretary, R. H. Chase, Broad and Bank Sts., Newark, N. J.

NATIONAL ELECTRIC LIGHT ASSOCIATION, SOUTHEASTERN SECTION. Secretary-treasurer, A. A. Wilbur, Columbus, Ga. Annual meeting, Isle of Palms, Charleston, S. C., Aug. 19-21, 1914.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago. Annual meeting, June, 1914.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass. Open meeting, New York, March, 1915.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, J. B. Earle, Waco, Tex.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 60 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, H. A. Faulkner, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, S. J. Stewart, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRIC RAILWAY ASSOCIATION. Secretary, Charles C. Dietz, 598 Broadway, Albany, N. Y.

NEW YORK ELECTRICAL CREDIT ASSOCIATION (affiliated with the National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York. Annual meeting, New York, June, 1914.

NORTHWESTERN CEDARMEN'S ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn. Annual meeting, Escanaba, Mich., Jan. 27.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, F. C. Green, 291 East Morrison St., Portland, Ore. Annual meeting, April.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary-treasurer, S. C. Pohe, Bloomsburg, Pa.

RAILWAY SIGNAL ASSOCIATION. Secretary-treasurer, C. E. Rosenberg, Times Building, Bethlehem, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. H. H. Norris, Ithaca, N. Y. Annual meeting, Princeton, N. J., June.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Texas. Annual convention, Galveston, Tex., May 20-23.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill. Annual meeting, Cincinnati, Jan. 27-29.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Annual meeting, Milwaukee, Jan. 15 and 16.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 23, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,081,941. ELECTRICALLY CONTROLLED SIGNALING APPARATUS; H. W. Aylward, New York, N. Y. App. filed Oct. 14, 1910. Ship telegraph system provided with means for indicating when system is out of order.

1,081,947. OUTLET BOX; E. W. Buffinton, Fall River, Mass. App. filed Oct. 7, 1912. A movable member clamps the conduits in the box openings.

1,081,990. TELEPHONE INDICATOR; T. L. Savin, Pine Bluff, Ark. App. filed Jan. 9, 1913. An indicator at the unattended telephone informs party calling where the desired party can be reached.

1,082,012. INCANDESCENT LAMP; A. G. Davis, Schenectady, N. Y. App. filed Sept. 28, 1907. The loop of a refractory metal filament is reinforced with refractory metal and an anchoring device loosely engages said reinforced bend.

1,082,021. ELECTRICAL SWITCH; H. R. Gilson, Baden, Pa. App. filed Oct. 17, 1912. Snap switch having a rocking switch-operating member.

1,082,032. CONNECTING DEVICE FOR ELECTRIC CONDUCTORS; N. D. Levin, Columbus, Ohio. App. filed March 11, 1910. For use in mines; solenoid prevents connecting or disconnecting when current is on; device is shown applied to a cable reel.

1,082,058. PROCESS FOR CASTING ARTIFICIAL TEETH; H. A. Wienand, Frankfort-on-the-Main, Germany. App. filed Aug. 27, 1912. Makes a metallic duplicate of the original and forms a mold therefrom by electrodeposition.

1,082,063. CARRIAGE-RETURN MECHANISM; W. Ammerman, Franklin, Tenn. App. filed Jan. 18, 1913. Includes a motor and electromagnetically controlled differential gearing which operates to return typewriter carriage and line space.

1,082,083. CONTROLLING MEANS FOR MACHINE RECORDERS; A. C. Johnson, Chicago, Ill. App. filed Feb. 12, 1913. For registering output of a machine and indicating the idle time.

1,082,092. RELAY DEVICE; A. Orling, Tooting, London, Eng. App. filed Oct. 6, 1911. Produces the angular displacement by a stream of air.

1,082,093. ELECTRICAL SNAP SWITCH; C. F. Paul, Peekskill, N. Y. App. filed Oct. 15, 1912. Rotary member which carries the contact plate is of elliptical shape.

1,082,110. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Feb. 7, 1912. Current-responsive means determines the mode of action of the voltage-responsive and current-responsive operating means for the generator-regulating means.

1,082,111. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed March 4, 1912. Includes operating means for regulating the generator, responsive to voltage fluctuations, and a second operating means responsive to the storage-battery current fluctuations.

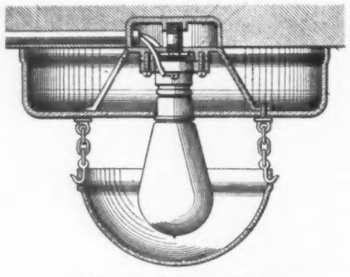
1,082,134. WATER-TIGHT JOINT FOR MAGNETIC CIRCUITS; R. C. Patton, Providence, R. I. App. filed April 25, 1912. A re-entering groove is provided at the abutting faces of two magnetic members to receive plastic calking material which hardens therein.

1,082,148. MULTI-RATE ELECTRIC METER; A. W. Burke, Wilkinsburg, Pa. App. filed March 11, 1912. Induction-type meter in which the registering rate is controlled from a central station by varying the voltage impressed on its shunt coil.

1,082,161. PROTECTING IRON FROM RUST; A. Lang, Karlsruhe, Germany. App. filed Sept. 30, 1909. Artificially produces a layer of iron oxide and then applies to such layer an aniline dyeing agent.

1,082,168. ELECTRIC HEATER; F. Philip, G. Kemp, Fort Arthur, Ont., and W. H. Gibbons, London, Ont. App. filed Nov. 1, 1912. Water or air passes from a secondary heating chamber through primary heating chambers in the form of spiral tubes about which the resistance wire is coiled.

1,082,181. ELECTRIC-LAMP SOCKET; W. C. Tregoning, Cleveland, Ohio. App. filed May 13, 1912. Has integral switch plate with a spring tongue, a terminal lug and a bearing for the switch spindle.



1,082,322—Lighting Fixture

1,082,184. TRACK CONTACTOR; C. W. Ward, Lakewood, Ohio. App. filed Feb. 3, 1912. Switch on opposite side of the track from the third-rail and operated by the inactive third-rail shoe on that side of the car.

1,082,187. APPARATUS FOR CHARGING STORAGE BATTERIES; C. E. Beach, Binghamton, N. Y. App. filed Sept. 24, 1910. System of interrelated relays. Ninety-three claims.

1,082,195. ELECTRIC FURNACE; A. Helfenstein, Vienna, Austria-Hungary. App. filed Jan. 29, 1913. Vertical electrode extends down through charging hopper and means are provided for exhausting the gases of combustion and for cooling the same and for preheating the charge.

1,082,196. ELECTRIC FURNACE; A. Helfenstein, Vienna, Austria-Hungary. App. filed April 16, 1913. Material is charged into the spaces between the charging chutes and the electrodes, which are suspended above the hearth, alternating with the chutes.

1,082,210. SWITCH MECHANISM; E. J. Pace, Los Angeles, Cal. App. filed Dec. 23, 1911. Station indicator embodying a stationary magnetic member on the trackway and switch mechanism on the train actuated by magnetic influence.

1,082,221. RADIO-TELEGRAPHIC STATION; G. G. von Arco, Berlin, Germany. App. filed Feb. 7, 1912. Employs vertical antenna for transmitting and low horizontal antenna for receiving.

1,082,248. CONDENSER TELEPHONE; J. Unterholzner, Zweibrücken, Germany. App. filed Aug. 13, 1912. Embodies an imperforate diaphragm and a perforated electrically charged condenser member operatively associated therewith.

1,082,272. STATIC PRESSURE SYSTEM FOR THE PROTECTION OF ELECTRICAL CONDUCTORS; G. N. Kercher, Los Angeles, Cal. App. filed Sept. 1, 1909. Alarm for protection systems in which the conductors are surrounded with a fluid medium under static pressure.

1,082,286. DIAPHRAGM FOR ELECTROLYTIC APPARATUS; H. D. Ruhm, Buffalo, N. Y. App. filed Oct. 2, 1912. Comprises one or more inner layers secured in position and one or more outer layers loosely retained in place.

1,082,289. TELEPHONE RECEIVER; M. Setter, Chicago, Ill. App. filed March 12, 1906. A non-magnetic cup holds the permanent magnet and pole pieces in proper assembled relation, and cord terminals are inside the shell.

1,082,295. ELECTROPNEUMATIC CONTROL-VALVE MECHANISM; W. V. Turner, Edgewood, Pa. App. filed June 29, 1910. Pressure in the chamber which controls the pressure in the brake cylinders is varied by electropneumatic means.

1,082,310. RELAY; J. Erickson, Chicago, Ill. App. filed March 31, 1911. Has means for varying the angle between the armature and its contact-controlling arm.

1,082,322. LIGHTING FIXTURE; E. F. Guth, St. Louis, Mo. App. filed Feb. 13, 1913. Semi-indirect; glass canopy supported from a ceiling member and a shade suspended from said supporting member.

1,082,397. SELF-LOCKING LAMP BULB; C. Blass, New York, N. Y. App. filed April 15, 1913. Spring lock on lamp base engages in interruption in the thread of the socket, from which it may be released by key inserted in grooveway in the lamp base.

1,082,404. ELECTRIC-LAMP SOCKET; A. W. Clauder, Bridgeport, Conn. App. filed May 6, 1912. Key socket with rotatable switch piece and transversely movable latch plate.

1,082,417. AUTOMATIC FUSE RESETTER; J. B. Elkin, Columbia, S. D. App. filed March 10, 1913. For automatically resetting a plurality of fuses in a telegraph or telephone circuit.

1,082,436. SIGNALING SYSTEM; J. Olsen, Rolfe, Ia. App. filed June 21, 1912. Has a rotating drum-circuit closer.

1,082,459. ELECTRIC FURNACE; J. Burke, Erie, Pa. App. filed Dec. 10, 1910. Electric furnace with electrodes connected with the secondary coils of a polyphase transformer, which coils are unconnected with one another.

1,082,475. VIBRATOR; I. C. Orswell, Hyde Park, Mass. App. filed June 3, 1908. For ignition coils; has a resilient fulcrum for the armature.

13,663 (reissue). ELECTRIC SIGNALING SYSTEM; J. D. Taylor, Edgewood Park, Pa. App. filed May 27, 1908. (Original patent No. 882,276, of March 17, 1908.) Track rails reinforced at block limits with laminated iron to increase their impedance.